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A New Turret Lathe.

With this we present an illustration of a turret lathe, built for brass workers' use, and similar work, and which possesses some new features worthy of attention by those interested in such tools.

A glance at the cut will show that it is provided with the usual chasing bar and other regular features of brass workers' lathes, and that the carriage has an automatic feed motion along the bed, by means of a belt-driven feed-rod and friction device, the same as an engine lathe. In addition to this feed there is a longitudinal slide immediately under the turret, which may be moved by the screw and crank-handle at the right, or, rapidly, by the lever shown between this handle and the turret; it being necessary only to tighten or loosen the short-locking lever shown beneath the slide, to change from one motion to the other. This slide is fixed in line with the shears, and is not changed for taper work.

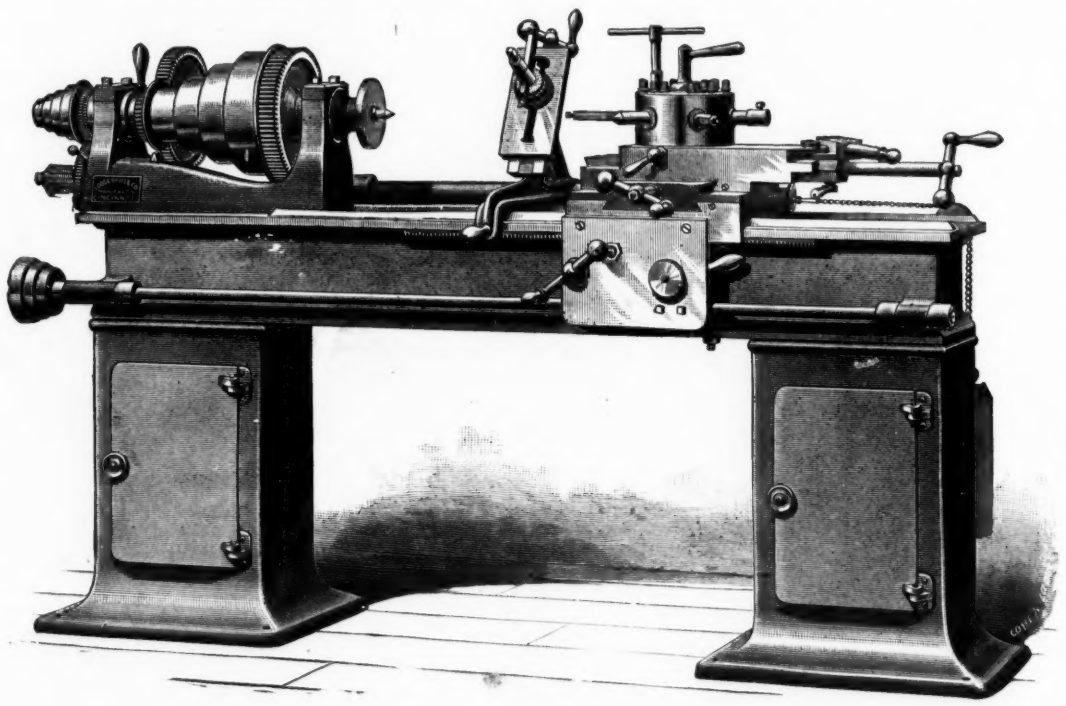
The next slide beneath it is a transverse one, worked by a cross-feed screw and handle, in the usual manner, and is also fixed, being always at right angles for facing.

Immediately beneath this is another transverse slide, which constitutes the especial new feature, and is used for taper work. It is moved across the carriage by a taper attachment which is between the shears, and is upon the same principle as the Slate taper attachment. The bar can be set to any desired taper by a graduated index reading to 64ths of an inch to the foot. When the taper attachment is not in use, a taper pin, which is inserted, holds the slide exactly central.

It will be seen by this arrangement all the advantages of the Slate taper attachment, as used on lathes, are secured. Taper work can be bored or turned either by power feed, or by hand movement of the carriage; at the same time, any part of the work which is straight may be turned or bored by the upper slide, without disturbing any adjustment, or re-chucking the work, and facing can be done square by means of the upper transverse slide, without disturbing the taper attachment. This obviates the necessity for making changes for facing work, parts of which are taper—a point which will be appreciated on a good many lines of work.

As will be seen, the legs are made into closed cabinets, useful for holding tools and fixtures, and the machine is back-geared, and strongly driven.

The builders are Lodge, Davis & Co., Cincinnati, Ohio.



NEW TURRET LATHE.

There is a United States statute that makes it a penalty to import labor, each offense of the kind involving a penalty of $1,000. This penalty has recently been enforced by Judge Wallace against the Church of the Holy Trinity, New York, for importing a pastor to labor in its field of usefulness. Without discussing the right or wrong of the law that provides this penalty, it is refreshing to find evidence that the law is to be enforced, while it remains on the statute books, without reference to the condition of those against whom it is aimed.

To Mould Cylindrical Work in Top and Bottom Flasks with Spindle and Sweep.

BY S. BOLLAND.

When a cylindrical casting is ordered, for which there is no pattern of the required diameter, the ordinary method is to make the job in loam, if practicable, or else lag up a pattern which is nearest to the diameter wanted; very often a new pattern is made at considerable cost, and never used afterwards.

All this annoyance and loss may be easily remedied by adopting the system which I propose to explain in this article. Furthermore I am convinced from experience that very many castings may be made in top and bottom flasks with the spindle and sweep as good, and in as short a time, as from a pattern, thus saving the cost of pattern making altogether in many instances.

Sugar mill rolls, rolls for copper and iron, pipes, shafts, side pipes, etc., are a few of the castings for which this method is eminently adapted, the only requisite for the successful accomplishment of which is a well proportioned set of flasks suitably equipped.

For the purpose of thoroughly explaining such a set of flasks in detail, I have selected a roll 24 inches diameter with 12 inch necks to mould. I am thus enabled, by aid of the several illustrations accompanying this article, to show more definitely than could otherwise be done, what is needed in their design and construction. As will be seen, I have not attempted to fill in every detail, but have simply given a general outline of the whole, with just enough of detail to make the explanation easy.

The best flask for moulding such work as rolls, pipes, etc., or any other plain cylindrical casting, is the one shown at Fig. 1 (page 2). As seen, the sides are drawn over sufficiently to allow of about as much sand between the flask and the casting as there is on the back, which in this case is about 6 inches: the width at the joint must be determined by the amount of room needed for the upright runners. By referring to *B*, Fig. 2, the reader will see the position of such runner as arranged for filling the mould in preparation. A common error in making flasks for this class of work is that they are not made proportionately strong at the outset, the result of which is that in a very short time they become dangerous, on account of their fractured condition, caused by the unequal expansion and contraction of the parts when in use. Let the sides of this flask be made of a uniform thickness of ¾ inch, and have the webs which connect the flanges come flush, and from 12 to 15 inches apart, as seen at *A*, Fig. 1, and depend upon it you will not have much trouble from breaks if ordinary care is exercised in the handling.

When it is necessary to strengthen any part of a flask on account of extra duty imposed there, do not (if avoidable) try to accomplish it by adding thickness, but add webs or brackets to give the strength needed. You then attain your object without a sacrifice of proportion.

Fig. 1 is a view of four such sides as I have been describing, placed in position. The ends are purposely left off, so that a view of the inside, showing the position of the bars *B* and *C*, can be obtained. Although the handles for lifting purposes are only shown at *D* and *E*, it is supposed that all the sides will have them. They are of wrought-iron, and need not stand out further than is required to pass the chain through for lifting and rolling over. When, as in this case, it is necessary to cast in a vertical position, the lugs *F*, *G*, *H*, *I* are used for raising the mould on end and lifting into the pit. Be sure that these lugs are well secured to the side by brackets cast on each side of the holes. The thickness between the brackets can be increased to 1½ inches, on account of the extra wear and tear of that particular spot. At *J*, is seen one of the plates which must be bolted along the back of the flasks when the bars are untrustworthy, or when the mould is so large as to make their use absolutely necessary. But with 6 inch spaces between the bars and 6 inches of sand from the mould to the back, the using of plates is superfluous, provided the bars are made as shown at *B*, *C*, with the flange for bolting to the sides continued across the back, the mould well rammed, and thoroughly dried. These remarks apply only to such moulds as we have under consideration, being not more than ten feet from top of pouring basin to base of mould.

Another common mistake in making these flask sides, is to fill them with holes other than the ones required for securing to the cross-bars; these are a source of weakness and should be avoided. If the holes for bolting the bars be made longer than their width, as shown, there will be sufficient opportunity given for the escape of steam and gas. I would here say that although I have shown all the slot holes in these views to have square corners, I favor the idea of rounding them at the ends, as they do not weaken the casting so much. Let the flange along the joint be set back so as to leave about ½ inch space when they come together; into which mud can be packed to prevent leakage when the mould is poured. I have shown this space in Fig. 1; it will also be observed that all the bolt holes for binding the two parts together are in close proximity to the webs. This, of course, obviates the danger of pulling away the flange when the flasks are being screwed together. It will also be seen that the bars *B* and *C* are shown solid all through. The reed marks on superfluous holes in the sides apply in this case as well; the fewer the holes the longer will be the life of the bar, and the whole thing will be benefited thereby. I deem it well to state that all box sides, for purposes such as we have been describing, should be cast under pressure; this gives them greater strength and they are easier to handle and fit together.

By referring to Fig. 2 it will be seen what kind of ends are required for such a job. This view gives an outline of as much of one-half of the flask as is necessary to explain the method of rigging the ends. *C* is the upper end, and, like the lower one, *D*, must in this case be made not less than 1½ inches thick. In addition to the holes for securing to the sides, as seen at *C*, there must be holes cast to correspond with those marked *E*, *F*, *G*, *H*, to be explained further on. The end *D* is plain along its upper surface, excepting a half hole at the center, to allow of the spindle passing through at *I*, but in end *C* provision must be made for the runners, as seen at *A* and *B*, and also for the feeding head at *J*.

The arrangement for the spindle is simple; four fixings are made, similar to the one shown at *K*, the inside edges must be planed true, placed together in pairs, and bored, one to take the body of the spindle, the other a little smaller; this permits of a little being turned off at one end of the spindle to shoulder on both sides of the fixing, and serves to prevent the spindle moving endwise, as shown at *L*.

This fixing not only serves as a bearing for the spindle, but, as will be seen, forms the joint also. When one has been bolted at each end of one of the flasks, as seen at *K*, Fig. 2, place in the spindle and set on the other flask, pinning it in the usual manner. *K* and *L*, Fig. 1, show two of the pin holes, and similar ones are supposed to be on the opposite side. The other fixings can now be brought over the spindle and bolted to the upper flask, taking care to have a close fit, with no possibility of their shifting during the operation of sweeping the mould.

Fig. 2 is a representation of the apparatus for sweeping the mould. The spindle *M* is resting on the bearings *K*, and the sweep *N* secured to arms *O* and *P* stand vertical to the swept mould. The surface of the joint is made to the planed edge of the end fixing by using a straight edge which rests on both ends, and must therefore be as accurate as the bearings themselves.

I have shown the runner for this roll extending along its length to the lower neck, at which place it is best to run these castings after the manner shown in section at Fig. 3. *B*, Fig. 3, is that half of upright seen in Fig. 2, and connects with gate *C*, so placed that the fluid iron, on entering the mould, shall strike the outer surface. This gives it the course indicated by the arrows, and of course imparts a rapid circular motion to the iron which drives the scum and dirt to the center, to be discharged into the feeding head when the mould has filled.

To prepare these moulds, begin by ramming the flask full of good ordinary floor sand, not over damp, strike off the joint about ⅛ inch below the fixings at the ends; mark off the mould to the sweep, and then cut out the sand about ⅛ inch clear of the sweep all over, then moisten the surface with thin clay water. It is now ready to be swept, and whatever has proved itself a good dry sand facing for heavy work will make a good loam for this purpose, by adding water sufficient to bring it to the right consistency for working easily. Let a little, which has been made extra thin, be rubbed well over the surface before the loam is applied; this helps it to adhere to the sand.

Whilst this is stiffening go through the same process with the other half, by which time the first will be hard enough to receive the finishing coat, which need not be any other than a little of the same loam thinned down with water and put through a fine riddle or sieve. For roughing it will be found best to push the sharp edge, and in finishing the chamfered edge through the loam, and should it be required to duplicate a job often, it is advisable to bind the edge of the sweep with hoop iron.

When the mould has been swept the joint can be finished off with the straight edge, the ⅛-inch clearance allowing of just so much thin loam being struck on at that part. This gives a good even surface, much superior to anything got by sleeking with the trowel.

I might here observe that where much of this work is done, a half runner of the required size could be made and bedded in the sand when the flask is being rammed; the same in regard to wobblers, etc., as shown at Fig. 4. One-half of these can be made to fit the spindle and rammed into position before the sweeping takes place. For the benefit of such as have not had any experience in mixing blacking for such jobs, the mixture given below will be found useful:

To 1 of best mineral, add ½ good heavy charcoal, ¼ of X X silver lead, ¼ of hard Lehigh blacking. Mix to the right consistency with clay water, just thick enough to color the hand.

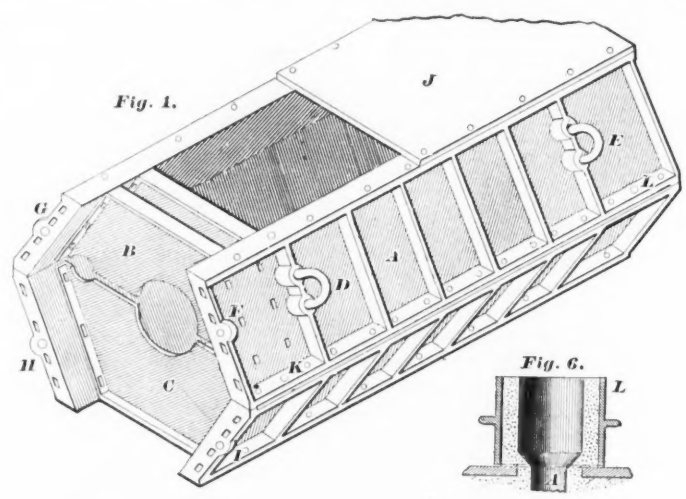
Whether the mould is blackened wet or dry, there should be about $\frac{1}{16}$ inch of this blackening brushed or swabbed all over it; but it is by far the best to blacken the mould whilst green.

I shall not waste time and space to prove the necessity of thoroughly drying all moulds, especially of pieces that are to be bored or turned, for it must be plain to the most ignorant that the freer a mould is from steam, the greater is the chance of securing a sound casting.

I do not consider rolls to be in any sense an exception to this rule; therefore, however urgent may be the demand, I deem it an injustice to the founder to expect a sound casting if time is not allowed for drying the mould before it is poured.

Fig. 5 is a view of this mould resting on end in the pit. The runner box *A* and feeding head *B* are shown in position. The pit has a 12-inch wall built around it, capped by a cast iron ring two inches thick. After the two parts are placed together and secured by bolts, as seen at *C* and *D*, ring bolts like the one shown at *E* are secured in the four end lugs, a short strong chain for the purpose can be hitched to the bottom rings and the mould raised on end; all four can now be

To prepare this runner, have a plate, *G*, made to clip the outside of the flask and the form of the runner box; cast wrought pins in to correspond with end holes, so that after the ring bolts are taken out the holes will serve to secure the plate to the flask. The frame marked *F* is now placed on the plate *G*, and the runner raised to the level of the frame by a core made for the purpose. When this has been rammed and swept off, it is ready to receive the running head, which having been rammed on a true surface, is readily rubbed down into place. Should there be no mould into which the spare iron can be poured, it is best to prepare a channel from the feeding head to a good sized pig in the floor, and run the whole of the iron through the mould. It is well, also, to keep the runner as much higher than



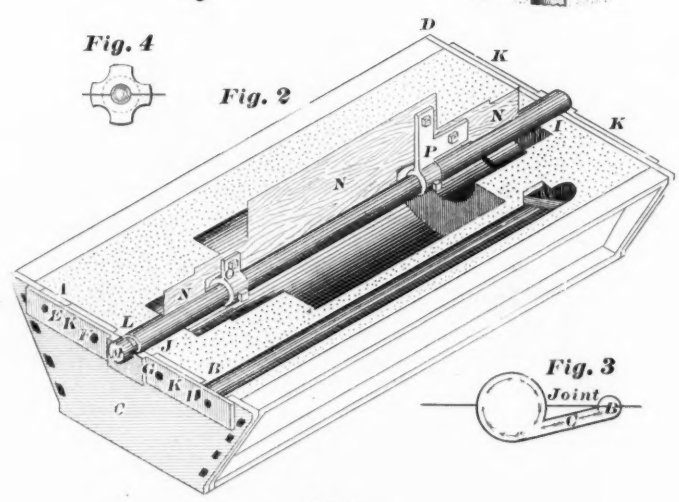
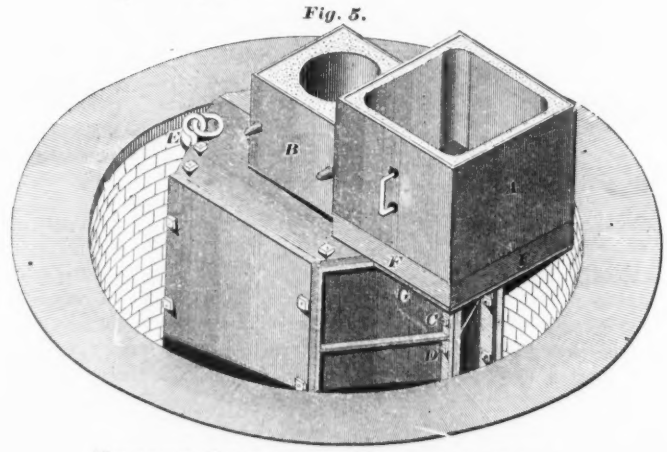


Fig. 5.



Moulding Cylindrical Work.—See Page 1.

used and the whole lifted clear and lowered into place in the pit.

Fig. 6 is a sectional elevation of the feeding head resting on the box; it is seen to increase in diameter until it is about the same size as the neck, and 12 or 15 inches deep. This needs to be done so as to have a supply of liquid iron above, to follow up the shrinkage which takes place in the mould immediately after it is cast.

It is wise in some instances, as when the iron is unreliable, or the feeding head necessarily small at *A* to use a feeding rod, pushing it through the head and down into the body of the roll; this keeps open the communication with the supply above and thus prevents a drawn spot at the junction of the neck with the body. The running head as well as the feeding head are best made in dry sand; it adds materially to their safety, besides being cleaner.

the feeder as will allow of most of the iron escaping from it through the feeder, as described, as it carries away the sullage and cold iron, and leaves a good supply of clean iron to follow up the shrinkage.

The general principles laid down in this description for making a roll will serve, with some slight modifications, for anything else of a like nature, and any of the ordinary top and bottom flasks can be converted into a spindle flask by having the ends made to suit.

Flange pipes can be swept very readily; brackets, nozzles, etc., can be easily attached by a system of block cores to be set to the sweep when the box is being rammed. Nor is this system confined to dry sand castings; for with a little practice as good green sand work may be accomplished this as way from the pattern.

Literary Notes.

TREATISE ON PATENT ESTATE. Comprehending Nature, Conditions and Limitations of Interest in Letters Patent. By Thos. B. Hall, of the Cleveland Bar. Ingham, Clarke & Co., Law Publishers, Cleveland, Ohio. Price, $3.00.

There is a great deal of misunderstanding in regard to the right of property under a patent grant, which is quite natural when it is considered that "common law" in the instance of property in patents, is by no means always "common sense." A knowledge of the facts embodied in this work would have enabled many an honest man to have avoided pecuniary loss, from reasoning that what was manifestly right was law. The next best thing to making law a part of justice, is to understand the injustice of law; hence we can cheerfully advise those who are interested in patents to study this book before counting their rights, in the law.

TABLES OF SATURATED STEAM AND OTHER VAPORS. By Cecil H. Peabody, B. S., Assistant Professor of Steam Engineering in the Massachusetts Institute of Technology. New York: John Wiley & Sons. Price, $1.00.

It would be an excellent thing if there were uniformity in the tables of saturated steam, and it would seem, since all authors of the present day work in the same light on the subject, that there should be. The table of Charles T. Porter is very generally used by engineers in this country, and Mr. Peabody's table agrees very closely with that of Mr. Porter. The author's table is very well arranged, and calculated for use either for variation of one degree temperature, or one pound pressure. It is given both in terms of English and French units, and represents a large amount of painstaking work.

The other tables are given in terms of French units only, which will restrict their utility for general purposes, since the majority of American engineers are accustomed to reason in English, and must state their conclusions in English if they expect them to receive any great amount of consideration.

The equations by the use of which the tables are calculated, and the considerations that led to their adoption, will be of value in technical school practice, and of interest to all who care to go into the reason of the subject.

The work is brought out in the usual good style of the publishers, and the steam table alone is well worth the price of the book.

If you ask a Frenchman here, Will the canal ever be finished? he will say yes, if he thinks he may be reported as expressing an opinion. But if he can trust you, he will say "never." You ask him also: "Will De Lesseps get more money?" "Yes," he replies. "The French government must aid De Lesseps. To have the work stop now, and to lose the money already put into it, would cause a revolution in France." Thinking men here upon the isthmus do not for one moment believe the canal will be finished. But so long as the money comes here, and merchants and others can grow rich, no one cares, and none want to see the work stop.—*Panama Correspondent Philadelphia Press.*

An Explosion of Powdered Sawdust.

James Langhorn's power block on Winter street was damaged to the extent of about $200 by fire last evening. The fire under the boilers was communicated to a vault filled with shavings and sawdust. It spread through the air shafts in which the shavings were forced to the vault by a "blower," and for half an hour baffled the firemen in their efforts to extinguish it. During the progress of the work the sheet-iron ceiling of the boiler-room was pulled down, and a cloud of powdered sawdust fell on the fire beneath. It ignited like powder, and a great sheet of dazzling white fire rolled through the doorway into the street.—*Cleveland Herald.*

Modern Locomotive Construction.

By J. G. A. MEYER.

SIXTY-SEVENTH PAPER.

In previous papers it was shown, that, in order to determine the amount of weight required to counterbalance the weight of the crank, we must first find the center of gravity of the crank. At the end of the sixty-third paper it will also be seen that, on account of the difficulty of determining accurately the center of gravity of the crank, many draftsmen and engineers will often, instead of counterbalancing the weight of the crank referred to the crank-pin, content themselves by simply adding the weight of the crank-pin hub to the other weights applied to the crank-pin, and then counterbalance the sum of these weights. Hence the question may arise: How can we find the weight of the crank-pin hub?

The weight of the crank-pin hub can be determined by the same method and rules which were employed for finding the weight of lead in the rim of a wheel, as explained in our last paper. Thus, for instance: Let Fig. 403 represent the longitudinal section of the crank-pin hub, whose weight we are to determine. We first find the area of the section of the metal *l m n o p*. To do this we follow Rule 48. Therefore, divide the distance *n p* into any number of equal parts, and through the points of division draw lines perpendicular to the line *n p*, terminating in the curve *m l o*. Let *A, B, C,* etc., represent the length in inches of these lines, (the lengths being obtained by measurement). Then, according to Rule 48

$$\left(\frac{A}{2}+B+C+D+E+\frac{F}{2}\right)\times S = \text{area in sq. in.}$$

We must now find the center of gravity *G* of the surface *l m n o p*. To do this, cut a templet to the outline of this surface, and find its center of gravity by the method shown in Fig. 377. Mark off this center of gravity *G* on the section of the hub, and measure its distance *G h* from the center line *i k*; twice the distance *G h* will be equal to the diameter of the circle whose circumference will be the path of the point *G* as the surface *l m n o p* revolves around the center line *i k*. According to Rule 49 the number of cubic inches in the hub will be equal to the product obtained in multiplying the circumference in inches of the circle described by the center of gravity *G*, by the area in square inches of the surface *l m n o p*. This last product, multiplied by the weight of one cubic inch of cast-iron (.26) will be the weight of the crank-pin hub.

Driving Wheel Tires.—At present, nearly all driving wheel tires are made of steel. The most common practice is to shrink the tires on the wheel centers, as explained in the fifty-sixth paper. When tires are to be shrunk on, they are bored out to a uniform diameter throughout, so that their sections will appear like that shown in Fig. 404. Of course the inside diameter of the tire must be a certain amount less than the diameter of the wheel center; care must be taken not to allow too much for shrinkage, as such will draw the tire too tight, and will be liable to burst it when the engine is running; on the other hand, with an insufficient allowance for shrinkage, the tire will, in a short time, become loose; the differences of these diameters adopted by the American Railway Master Mechanics' Association are given in the fifty-sixth paper.

When steel tires are properly shrunk on the wheel centers in this manner, they will remain tight and resist all the lateral thrust caused by the flanges bearing against the rails, until they are worn considerably. Then these tires need watching, as the constant rolling action is liable to loosen them. When this is the case, shimming pieces are often placed between the tires and wheel centers. Occasionally, the excellent plan, as shown at *A* in Fig. 404 is adopted. Here it will be seen that a slight projection or flange is left on the periphery of the wheel center near its inner face, or flanged side of the wheel. The purpose of this design is that the projection shall receive the thrust caused by the flanges bearing against the rails, and prevent the tire from slipping inward, should it any time become loose. Yet it seems that the general inclination is to avoid the extra expense incurred in putting the tires on the wheel centers in this manner, and consequently the most common practice is to bore out the tires straight.

Very seldom do we find tires which have not been shrunk on, but placed cold on the wheel centers; in fact, we know of only one road in the United States where this practice prevails. On this road the tires are bored out, tapered, and the periphery of the wheel center turned to suit, as shown in Fig. 405. The large diameter of the bore of the tire is on the flanged side, or, in other words, on the inside of the wheel. The tire is prevented from slipping outward by the hook-headed

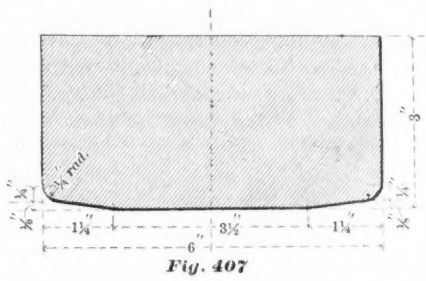


Fig. 407

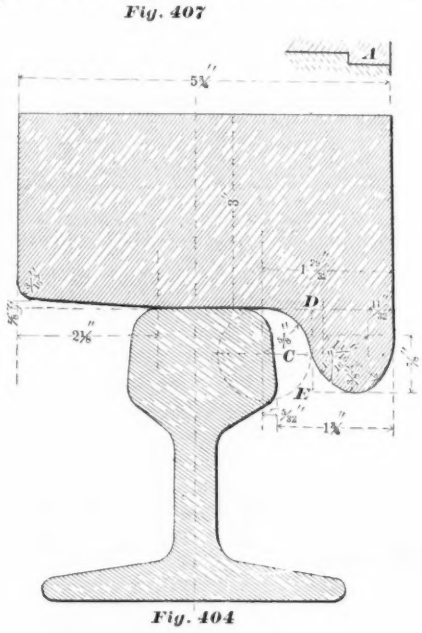


Fig. 404

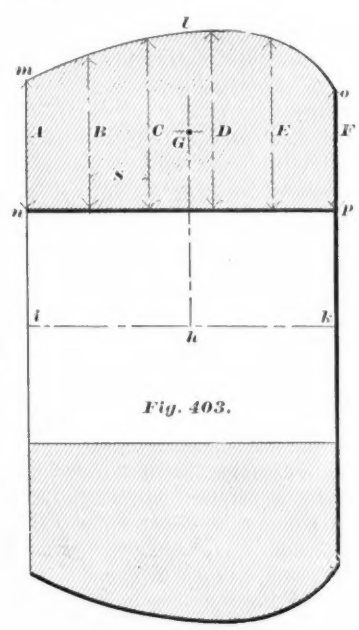


Fig. 403.

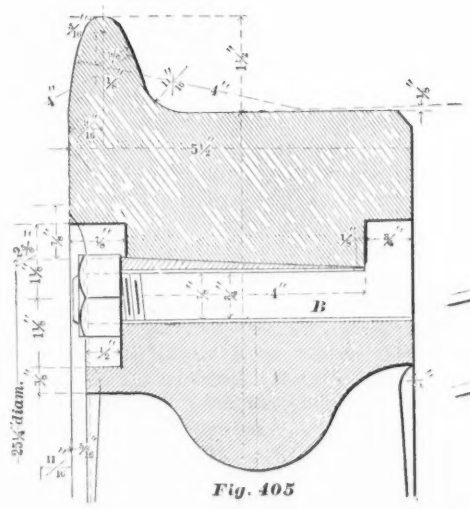
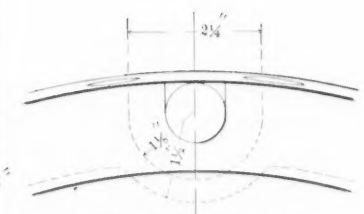


Fig. 405



Rim of Wheel Centre

Fig. 406

bolts *B*. The taper prevents the tire from slipping inwards, and resists the thrust caused by the flange bearing against the rails. Eight hook-headed bolts *B* are generally used for a tire 63 inches inside diameter; and six bolts *B*, for a tire 25¼ inches inside diameter. The nuts on these bolts are not allowed to project beyond the inside of tire; consequently, recesses for the nuts are cast in the rim of the wheel center; another view of one of the recesses, and metal partially surrounding it, cast to the rim, is shown in Fig. 406.

The advantage claimed for this mode of putting tires on the wheel centers is that they can be removed, when necessary, with less labor and delay than will be required for removing tires which are shrunk on the wheel centers, and also, should the constant rolling action loosen the tires at any time, they can be quickly tightened. We decidedly prefer the tires shrunk on wheel's center, as we believe that, with these, safety is promoted and better results obtained.

In fitting up a pair of driving wheels the wheel centers are first pressed on the axles, with a pressure equal to that given in the fifty-seventh paper. The keys are then driven, and the tires shrunk on. After this the wheels and axle are placed in a quartering machine and the holes bored for the crank-pins. It is very important to have the crank-pins exactly in line with the axle, and at equal angles in all the different driving wheels, and such results are obtained in a correctly designed quartering machine.

The crank-pins are then pressed into the wheel centers with a pressure of about six tons for every inch in diameter of the crank-pin fit, providing the holes are perfectly true and smooth. If the holes are not perfectly true, which may not only be due to bad workmanship, but may be, and sometimes is, the result of the bad practice of shrinking the tires on the wheel centers after the crank-pin holes have been bored, a pressure of 9 tons per inch in diameter is necessary for pressing the crank-pins into the wheels. The last operation is to turn the tires to the correct gauge.

Clearance between flanges and rails.—The tires are placed on the wheel centers so as to allow a certain amount of clearance, *C* (Fig. 404), between the flanges and the rails. The most common amount of clearance allowed at *C* for each wheel is equal to ⅝ of an inch, making the total clearance between the rails and the flanges of a pair of driving wheels equal to ¾ inch. On a few roads this clearance for each wheel is only ¼ inch, and, on the other hand, we occasionally find this clearance increased to ½ inch. We are in favor of ⅝ inch clearance for each wheel. Should the distance between the rails of a curve be established, and any doubt exist as to the sufficiency of this amount of clearance in running over the curve, the proper amount of clearance can readily be obtained by making a plan of the curve, and also a plan of the wheels with the correct distances between the axles, drawn upon the former; the distance between the flanges of a pair of driving wheels can then be regulated to allow a necessary amount of clearance, which will prevent the wheels from binding in running over the curve.

Fig. 407 represents a cross-section of a tire without flanges; tires of this kind are generally called "plain tires." These tires are generally wider than the flanged tires under the same engine.

The width of the plain tires must be made to suit the curves over which the engine has to run, and should be sufficiently wide not to leave the track at any time. To determine this width, a plan of the curve and wheel base must be made, and the width of the plain tire regulated so as to cover the rails at all times. As a consequence, the width of the plain tires vary, under the different classes of engines, from 5¾ to 7 inches.

Humors of the Press.

The Stiles & Parker Press Co. recently dedicated their new shops at Middletown, Conn., by a grand ball, upon which occasion the order of dancing was made to conform to the technicalities of presswork. Those who are up in press nomenclature will see the significance of such names as the following, even when applied to grand marches, quadrilles, waltzes, reels, etc.: "Stop Motion," "22 Central Swing," "204 Toggle Joint," "3,500 lb. Drop," "Crank Lifter," "5 Stiles," "291 Foot Squeezer," "Taper Tip," "300 Swage Block," "Combination Dies," "Conn. Valley Open Back," and other terms of equally suggestive import. The affair is said to have been a particularly enjoyable one.

A Scientific School in Siberia.

Mr. Geo. Kennan, in the current number of the *Century*, makes some statements regarding Siberia which will be a genuine surprise to most people.

Among other things found there, which one would hardly expect to find in such a country as Siberia is popularly supposed to be, is a scientific school at Tiumen, which he compares to the Boston Institute of Technology. It is called the "Realnoi Uchilishche." It occupies the largest and finest building in the town, and was erected and equipped by a wealthy citizen of Tiumen, at a cost of $85,000, and presented to the city.

It has a mechanical department, with a steam engine, lathes and tools of all kinds, and a department of physics, with fine apparatus, including even the Bell, Edison, Dolbear telephones and the phonograph, a very complete and well-equipped chemical laboratory, a good library and a department of art and mechanical drawing.

When one remembers that Tiumen is 1,700 miles east of St. Petersburg, in a country which most every one firmly believes (until he reads Mr. Kennan's article) contains nothing but snow and exiles, the above statements are somewhat remarkable.

News of the latest scheme for the formation of a gigantic stock company comes from Springfield, O., and from a local paper we learn that Mr. J. W. Bookwalter, not being satisfied with the ownership of a large manufacturing establishment there, and with having secured the title to an uncommonly large share of the soil of the West, if not the largest share belonging to any one man, has now secured the American rights to manufacture steel under a French patent. This process, we are informed, is a secret one, yet has been patented in this country, and is to entirely revolutionize steel manufacture and reduce its cost to—well, almost nothing. Pig iron is put into a cupola, and "in eleven minutes comes out finished steel in shining bars." "Every steel manufacturer must purchase the right, because otherwise he cannot compete with it." No doubt the large steel manufacturers of the country will be much surprised to learn that they have been outdone in this manner, and must discard their present methods entirely and adopt this secret, patented, French process, and we, shall also be surprised.

English Boiler Inspection.

By W. H. Booth.

EIGHTH PAPER.

Some years ago, at a time when attention was being more particularly drawn to the disadvantages attending the use of wet steam, and the economy resulting from superheating, probably owing to the researches of the late Prof. Rankine, a method of fluing boilers was introduced, for which great things were claimed. The so-called improvement consisted in encasing the crown of the boiler in an arch of brickwork, built at a few inches from the plates. Through the space thus left, or in other cases into it, the furnace gases passed on their way to the chimney, so it was claimed drying the steam, or even to some extent superheating the same.

Now it is argued by some that this arrangement can make but little difference in the quality of the steam produced. Others again argue that the arrangement is liable to cause overheating and brittleness of the steel plates. Public attention was, rightly or wrongly, drawn to this system by a terrific explosion of three boilers simultaneously in the town of Blackburn.

The three exploded boilers were seated side by side and overflued in the manner described. One went first and caused the explosion of the others. Some attributed the explosion wholly to the overfluing, and one result of the explosion was to cause a discontinuance of the practice. Investigation showed that the plates were far from good in quality, and a secondary result was that the makers of the boilers, instead of being ruined in reputation by the calamity, bestirred themselves, until now they stand second to none as makers of first-class boilers. Whether overfluing was or was not the immediate cause of the disaster, further reflection and investigation brings other possible causes to light. The brickwork of the overflue arch was stout and good. It closed in tightly round the manhole mouthpiece of cast-iron which thus projected just above the brick arch, its flange probably resting on the brick arch as in the annexed sketch, Fig. 1.

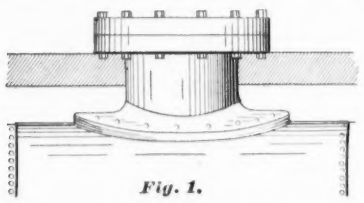


Fig. 1.

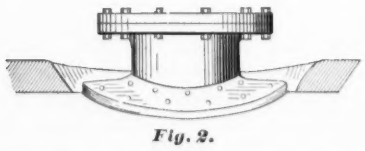


Fig. 2.

Now it is supposed that, as is almost invariably the case, the brickwork of the seatings would settle some. Such being the case, if the side walls, which were the abutments of the overflue arch, did not settle so much, the support beneath the boiler being removed, the weight thus relieved would all be carried by the manhole casting whose flange rested on the arch. If this were the case, as seems very probable, there is no reason to doubt that a boiler so suspended would be very likely to fracture at or near the manhole, as appearances tended to show had been the case. Hence the explosion. There is, therefore, great danger to be feared when an unyielding covering arch is fitted up closely to manhole or other fitting blocks, and hence it is always advised that when such unyielding brickwork coverings are employed, they must stop clear of all fitting flanges, as shown in Fig. 2, or of anything which could act as an obstruction against the free movement of the boiler beneath its cover. On the same principle, chiefly to prevent destruction of the end wall, it is customary to allow the front head to project four or five inches clear of the front cross wall. Such a plan also is good, in that it shows any possible leakage at the connecting angle iron of the end plate and shell. Generally speaking, however, we should repeat that brick coverings ought to be avoided where possible, and some material which will alter its appearance when moist should be used in place of bricks.

The lesson of the Blackburn explosion has not been forgotten, and from it much good has sprung in many ways; for it was this explosion of comparatively new boilers which drew so much attention to the dangers which surround the whole position. Heretofore new boilers had not been expected to explode, and yet it was seen and learned that other qualities than mere newness were necessary to secure safety.

Practical Details of Case-Hardening.

By B. F. Spalding.

ITS OBJECTS—DIFFERENT FROM CEMENTATION—STEEL MAKING—MATERIAL—BONES—PHOSPHORUS—ORNAMENTAL COLORS—RETORTS—BRICK—FUEL—BOXES—COVERS—"BRASYNE"—HORSESHOES—FIRING—RIGHT HEAT—QUENCHING—TESTING.

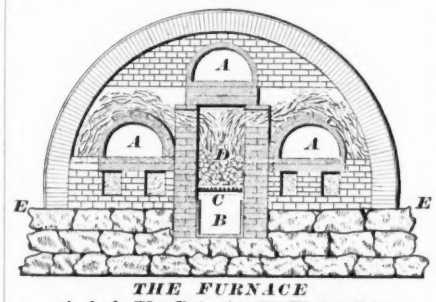
A peculiar and very useful property of wrought-iron is that by certain processes it can be hardened on the outside surface, while beneath this surface it remains soft. The process by which it is thus enclosed in a coat of mail is termed case-hardening. Whether the work is actually enclosed in a case or box to perform the operation or not, the name is still applied.

In case-hardening, the object aimed at is to add to the outer surfaces of the pieces which are to be operated upon some substance which will combine with the iron, and endow it with the quality of becoming hard when suddenly cooled from a red heat. This object is accomplished by having the pieces surrounded with some material which, when it is rarefied to a gaseous form by heat, will enter among the particles of iron which the heat has forced apart, and form, with them, the combination desired. For this purpose, the popular supposition is that pure carbon is the most desirable, but it is found that to have it readily permeate the metal the presence of nitrogen is of advantage. This is proved by the well-known fact that good case-hardening can be done much quicker with animal than with vegetable charcoal.

In the process of cementation, which is used to convert bars of iron into blister steel, the charcoal of hard wood is used as the carbonizing agent, and it is said that a small amount of salt and wood ashes is also introduced to flux the silica, and prevent the absorption by the iron of silicon. As far as it goes, the process of case-hardening is the same as that of cementation. As the term is generally understood, the process of cementation is incomplete until all the iron subjected to it has been impregnated, and its nature changed by combination with the foreign matter introduced in the "brasyne" or packing; but in case-hardening it is not desired or intended to change the nature of all the iron, but only to permeate it to a certain depth, leaving the surface hard, and beneath that the natural iron, retaining its fibrous strength and other original qualities pertaining to it. As a long exposure to heat is injurious to these qualities, it is desirable to produce the effect with as short an exposure as possible, and as animal charcoal accomplishes the result with greater facility than vegetable, its use is to be preferred. Bones, hoofs and horns are sometimes employed for this purpose; sometimes old leather is used, and, in some cases, either prussiate, chromate, or cyanate of potash is substituted.

It is less necessary to understand the chemical reactions of these substances than it is the physical effects they produce. Where bone is used, these depend upon the quality of the bones; for, although bones are bones, there is a great difference in their properties. Good fresh bones contain 80 per cent. of mineral matter and water, and 20 per cent. of animal matter, while old, weather-beaten bones have parted with the animal matter. In slaughter, packing and rendering establishments they are submitted to a steam pressure of 130 to 150 pounds per inch in closed vessels, and when they are taken out there is not animal matter enough left in them to round out the form of an emaciated flea. The principal proportion of what is left is in the form of phosphate of lime.

I asked for practical information on this subject of the superintendent of an establishment where from 1,600,000 to 2,000,000 pieces, weighing about a pound each, were hardened annually. He had studied into the matter very thoroughly, as was his wont, and although he was averse to expressing a decided opinion, which was not supported by any other authority to which he could refer, yet I certainly gathered, from the tone of his conversation, that he suspected that phosphorus had a considerable part in producing the results which followed from heating iron with calcined bone and cooling it in water. One reason for this was that iron that has been hardened with burnt bone is very liable to become brittle. It has been found necessary in making articles which have to undergo this process to be very particular and avoid using iron which contains much phosphorus. One cause of what is called cold-short iron is the presence of phosphorus, which, in a heated state, does not exhibit its baleful influence, but which seems, on cooling, to envelop every particle of iron with a very thin film, which is, however, sufficient to separate it from its neighbor far enough to weaken the bonds of attraction. Theoretically, the cure for this would be less phosphorus, but practically, the remedy seems to lie in counteracting its effects by uniting with it iron containing more sulphur. How this produces the desired effect, it is, luckily, not essential to know.



THE FURNACE
A.A.A. The Retorts. B. Water Pan.
C. Grate D. Fire Place. E.E. Ground Floor.

Probably case-hardening was first introduced for its hardening results exclusively, but when it was found that most beautiful and permanent colors could be obtained on clean surfaces by this process, considerable pains were taken to remove this secondary result from the category of accidents, and it became, in many instances, an object of even primary importance. It has obtained its greatest consideration as being ornamental by its use on parts of pistols and sporting guns, although it may have been first used for this purpose on cotton machinery. It was thus used in Lowell as early as 1830. Its fanciful use on machines is appreciated more and more, and responds to the criterion of correct taste, which demands that any ornate display of color shall not be discordant with nature.

In the manner indicated, it has come about that the term "case-hardening" is now indiscriminately applied to processes intended either (1) to harden only; or (2) to harden and color; or (3) to simply color articles made of iron.

In work of the first class it is customary, in some places, to pack the articles in the ground bone and expose them to heat for 22 hours. In these places the arrangements for heating are the same as were used in making gas, before the invention and use of the exhausters made it possible to reduce the initial pressure so low that clay retorts could be used for generating the gas, and the same kind of cast-iron retorts that were then used for gas are now set in furnaces to receive the boxes in which the work is packed for case-hardening. These retorts are semi-cylindrical shells, flat on the bottom, which is about two feet wide; the top, arching over, is about one foot high, and the length is some eight and one-half feet. These shells are one and one-half inches thick; they are closed at the back end, and the front end, which is open, is provided with a cap that can be fastened in its place by a screw, which swings out of place when the cap is to be removed Three of these retorts are heated by one furnace. They are set, one immediately over the furnace, on fire-brick tile, which protects the iron from direct contact with the flame; and one on each side of the furnace with the tops about the thickness of a brick lower than the bottom of the upper one. An arch is turned over these, enclosing them in a chamber. The fireplace is some three feet long and one foot and a half wide. The grates are pieces of one-inch iron and are each separate and movable. There is a water pan beneath them. On each side, beneath the upper retort, are two openings of the size of a fire-brick, 9″ x 4½″, in the walls of the fireplace, through which the fire has access to the chamber, where the upper parts of the three retorts are exposed. The fire goes from here into flues which run lengthwise underneath the side retorts, and then back into flues which run over and under an oven for drying bone which is built on the backside. Arrangements are made with dampers to shut the draft off entirely and to turn it on or off from the ovens at pleasure. The draft is furnished by a chimney forty-five feet high, the flue of which has a cross-section two feet square.

This bench of three retorts is the unit of the plant, and to increase it any number may be added. Two of them, side by side, make a pair, which can be easily come at to reconstruct whenever the retorts or fire-place burn out. One chimney will serve for four double benches. Benches of five retorts have been tried, but the results were not economical.

The cast-iron retorts are kept red hot all the time by constant firing, and will last from six months to two years. Their endurance depends upon the skill with which they are set, the refractory nature of the fire-brick, with which their points of greatest exposure are protected, the attention and skill with which they are fired, and the nature of the fuel. The best fuel is non-coking, bituminous coal, with some coke occasionally as ballast to keep a steady heat. They are run constantly day and night.

Here let me remark that if money was ever foolishly thrown away it is in purchasing poor fire-brick, either because they are cheap, or because it is more trouble to get those which the dealers cannot make as large a profit on.

When the furnace is new it should be slowly fired at first, and if it is four or five days before it is hot enough to receive work, it will last all the longer. The boxes in which the work is to be packed may be 18″ wide, or if less, they should be of such width that two or more can be got into the retorts, side by side, without crowding. Their length will depend upon the size of the work to be hardened.

The packing of the work is a matter of great importance, as it is to be so long kept hot that, unless it is well packed, it is liable to bend, either from its own weight, or from the weight of the pieces above it. The cover, also, should be well made to keep the work of as uniform temperature as possible. The covers are sometimes made of iron, luted on with clay. The whole cover can be made of a cement, made by mixing the old burnt-out bone with enough common clay to bind it together. If too much clay is used the covers will crack. Boxes 24″ long, 8½″ wide and 6″ deep, have been filled with saw dust and covered with this material, and then exposed to the heat of the retort for twenty hours. They were then taken out and set aside for two days, until they were cold, and when the cover was lifted off from the top of the charcoal thus formed, the always curious pyrophoric phenomenon was exhibited of the ignition of the charcoal by the avidity with which it absorbed oxygen the moment it was exposed to the air. This shows that the covers had given very close protection. Sometimes the old bone is depended upon without the addition of clay. The depth of the hardening is from $\frac{3}{32}$″ to $\frac{3}{16}$″ on iron which is free from phosphorus. Some iron will become phosphorus steel, and then harden entirely through. Work can be phosphorized or carbonized in these retorts, and worked over hot to some extent afterwards, and subsequently hardened. The short exposure to heat in working it over not sufficing for the equalization of the hardening matter

in the mass, it remains on the outside, and still forms an outer coating of steel. In this way the stub ends of rods are treated, and after being welded on, they are reheated and hardened as well as though they had been quenched in water when first taken from the box. I have treated horseshoes in this manner, which were afterwards heated and fitted, and then heated and hardened. They lasted so long that the horseshoers condemned them in unqualified terms. If it were not for this objection of interminable durability, the bars of which shoes are made might be steeled to the depth of $\frac{1}{8}''$, and the shoes hardened after they were fitted by the farrier.

The packing of the boxes is done on benches situated at a comfortable distance from the retorts, and in convenient proximity to the bins containing the ground bone. The method of packing is by putting into the bottom of the box a layer of the bone, and bedding in this the pieces which are to be hardened. The bone is filled in between them, and if there is room enough, another layer of bone is put in, and other pieces embedded in this. Care is taken that there shall always be sufficient bone between the pieces. If round shafts touch each other the touching sides will be soft. The top of the last row must be at least an inch below the top of the box. A layer of bone one-half or three-quarters of an inch thick is then laid on, and on this is placed the cover, as already described.

When the boxes are prepared, and the oven is ready to receive them, they are sometimes lifted in by the main strength of two or three men, or when they weigh from 300 to 500 pounds the better plan is to run them in on an inclined plane, which is simply an iron-bound plank reaching from a low trestle to the mouth of the retort. When brought from the packing bench and laid on this plank, they are easily rolled into the retort, and shoved into place with stout porter bars. When the retorts are full the mouths are closed, and the furnaces are then fired.

The work in the boxes is hot enough in two hours for the promotion of the chemical reactions, and then a steady heat is maintained for nineteen hours, and gradually lowered, during another hour, when, upon removing the door of the retort, the boxes will be found of a dark red color. They are drawn out and slide down the plank, the lower end of which is now resting on the ground. They are then drawn on an iron track to the water tank. The cover is taken off and the work will be found of a full red color, and should not be too bright. There is a certain red that the water seizes upon with the greatest avidity and cools the quickest. This is the color desired. A round shaft which has been treated exactly right is crowned with a delicate wreath of light blue flame as it sinks endwise beneath the water. This is the gas which continues to the last to form, by attraction, an atmosphere of its own around the hot shaft, and is forced to remain above the water while the shaft goes down and curls in a luminous circle above it as it disappears.

The pieces are taken from the boxes with tongs and placed in the water, with whatever care is necessary to prevent them from warping. When they are thoroughly cooled, the water is drawn from the tanks, the work thrown out and laid upon plates of iron placed on the hot-boxes, where it is quickly dried and thus prevented from rusting.

Meanwhile the fireplace has been clinkered, the retorts are filled with a new charge and the work again proceeds.

Although the hardships of the service to which these pieces are put are very great, it has not been found expedient to submit them individually to any test except for hardness, and it is only occasionally that one is tried to ascertain whether they have not lost the peculiar properties of wrought-iron, which it is the object of case-hardening to preserve. Responsible parties who make good all reasonable breakages conceive this to be more satisfactory to customers than to subject parts to undue stress and weaken them by the consequent strain and then demur at repairs, on the plea that previous satisfactory tests sustain the imputation of unreasonable usage.

A correspondent of *The Millstone* has been indulging in the luxury of steam power in place of water and discourseth thus:

We dreaded steam, but now would not use water power, unless under the most favorable circumstances; and there are doubtless many others who, were they to put in such a plant as we did, would walk out to the old flume, now dry and decaying, and noting the progress of the destroying elements, would think as we feel like saying: "Depart in peace, good and faithful servant. We thought you a cheap power, but were deceived. We have fought, bled, and (almost) died together. You have sulked in high water and times of heavy ice, and soured and fumed in times of drought. You go your way and I will go mine. The partnership is dissolved and I rejoice. Peace be with you."

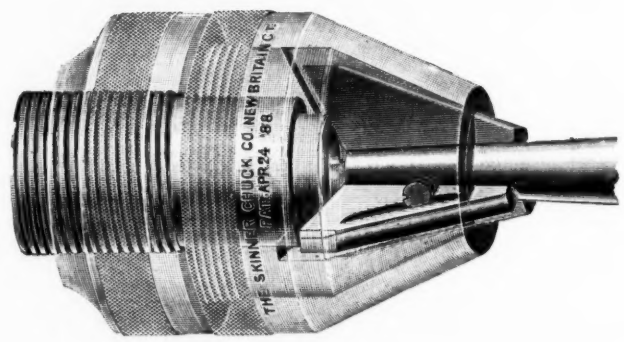
A Chuck for Taper Shank Drills.

We illustrate herewith a chuck for holding drills and other tools having taper shanks, made by the Skinner Chuck Company, New Britain, Conn.

From an inspection of the engravings its construction will readily be understood, and will be seen to be quite simple.

The outer rounded edge of the jaws comes in contact with the inner surface of the cap, and the inner or gripping edge is made at such an angle to it, as to make it fit the standard taper shank. When the body of the chuck is turned by the hand in the usual manner, it is screwed back onto the threaded stem which is in the center of the chuck, the conical end of which, coming in contact with the back end of the jaws, forces them together, thus gripping the shank.

FIG. 2.



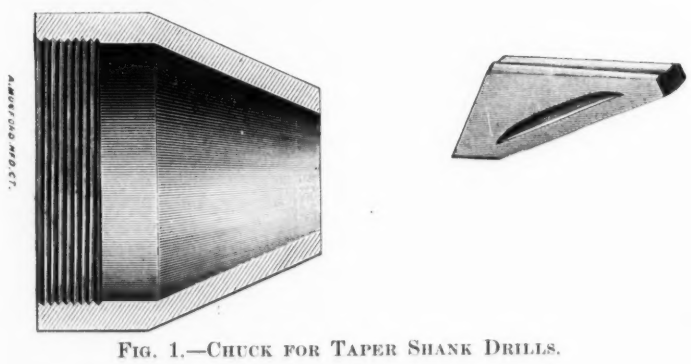


FIG. 1.—CHUCK FOR TAPER SHANK DRILLS.

Fig. 1 shows the chuck as constructed for taper shanks, and with detached views of the cap and jaws. Fig. 2 shows it as made for straight shanks; the construction being the same in all respects, except in the case of the jaws.

They are made of the best machinery steel, except the jaws and wearing parts, which are of hardened tool steel. They are easily taken apart for cleaning and oiling, and that for taper work requires no wrench to operate it.

A correspondent of the *American Manufacturer* says:

It is flattering to American bridge builders that at last English engineers are beginning to adopt the style of bridge construction which is adopted in America for large spans known as the pin-connected type. Hitherto English bridge builders have been frightened to adopt this style of construction, and have declined, with the customary English conservatism, to dare the experiment of adopting the American style. Now, however, no less eminent an engineer than Sir Douglas Fox, C. E., has specified this type of construction for a number of bridges designed for the South Indian railway, and the Butterley Iron Company (limited), Rotherham, are now engaged upon their manufacture.

LETTERS FROM PRACTICAL MEN.

A Question as to Heating Feed Water.

Editor American Machinist:

Can you or any of the intelligent readers of your valuable paper inform me if it is possible to account scientifically for the statements of some manufacturers of feed water heaters, backed by certificates of those claiming to be expert engineers, that they can heat water to a temperature of 216° with exhaust steam under no pressure whatever?

"A stream cannot rise higher than its source," and no substance can impart more heat than it contains; therefore, as it is a law of nature that steam, with nothing but the pressure of the atmosphere to resist its expansive force, can under no conditions contain more than 212.8° of heat, how is it possible for it to impart more than that temperature to water, especially through a thickness of metal, as is claimed?

Perhaps these claimants reckon as did a certain boiler maker, who was asked if he could make a boiler that would be safe, to run with 200 pounds steam, and he replied: "No, but I can make two that will be perfectly safe under 100 pounds each."

Or, in other words, if a certain volume of exhaust steam passing through their heaters raises the temperature of the water to 212°, an additional volume will raise it still higher—that's logical, certainly. But I believe they do not pretend to account for this wonderful phenomenon, but rely upon instruments to prove their assertions, and in some cases they give the names of the makers of those instruments, as if that was not only a guarantee of the correctness of the instrument, but also of the application of it.

Suppose we are running an engine that cuts off almost instantly, so that only sufficient steam is admitted to fill the space between the piston and cylinder head at the beginning of the stroke, then the piston moves down until the pencil of an indicator, that indicates correctly, reaches or goes below the atmospheric line before the exhaust port begins to open, will any one inform me what takes place when the exhaust port does open? Will anything pass out into an exhaust pipe or heater, and, if so, is it steam, air or water, and what forces it out?

If you enter a hot room and find a thermometer hanging there, indicating the temperature at zero, you can be absolutely certain of one of two things—either that instrument is out of order or your nerves are. And if some inventor should claim that he could construct a room in which people could sit comfortably in their shirt-sleeves with the thermometer at zero, I presume he would find some fools in this world who would believe it, and give him orders, provided he charged a big price.

My business for more than twenty years has been in connection with steam engineering, and for the past few years I have given a great deal of attention to the saving of fuel by utilizing the exhaust steam, and if there is, *in fact*, any way to preserve the heat of steam after its expansive force is entirely expended, I shall be very thankful to any one who will explain the process.

W. H. BAILEY, M. E.

Light Locomotive Slides.

Editor American Machinist:

It is gratifying to note how, as time passes, Chordal's letters are becoming oracles of wisdom and authority in mechanics, to be quoted by many of your correspondents in justification of some disputed point in theory or practice. Even the writer has had his staid notions upset by some of those witty and pointed illustrations.

A case in hand: we have severely criticised the very light locomotive slides made by some builders. After all, this may be, unwittingly on the part of the builder, just the thing to allow oil to get between the surfaces of slides and crosshead, by the very slight spring produced by the angularity of the rod. I get this from the axle-box theory of Chordal, and believe it to be correct within certain bounds.

CHIP.

A Hack Saw Expedient.

Editor American Machinist:

I made an experiment the other day that might interest some of your readers. My father owns a small shop here, and it is a job to get some tools that we need. Often we have to wait weeks for the tools to come from the factory. This time we were out of Star hack saw blades, and having considerable sawing to do we were "in a box." But something had to be done, so I took a chisel and scraped it on the blade till I broke the last tooth out. Then I had a set of teeth that were not as pretty or as good as the original ones were, but they got there all the same.

E. H. PEARCE.

Baton Rouge, La.

Magnetic Force Acts Through Every Known Substance.

Editor American Machinist:

In your issue of April 21, in reply to a question as to whether there is any substance through which magnetic force will not act, you reply, "not that we are aware of." It is, however, a fact that magnetic force will not act across a screen of iron or other magnetic substance, as nickel, cobalt and a few other substances. For a statement of this, and description of experiment to prove it, see "Elementary Lessons on Electricity and Magnetism," by Silvanus Thompson, p 77.

J. R. S.

[The statement in the book to which our correspondent refers, says that "a magnet enclosed in a hollow sphere of iron, is unaffected by outside magnetic influences." This, however, is not due to the iron being an insulating substance at all, because it is is not an insulating substance. Two magnets, between which a sheet of iron is interposed, still abstract each other, and will do so through any known substance, through a flame, through any known gas or through a vacuum. The fact that a sphere of iron acts in this way seems to be due to a balancing or absorption of the magnetic force, due to the form in which the metal is disposed, rather than to the character of the metal itself—a fact which seems plainly demonstrated when we consider that if the half of the sphere furthest from the outer magnetic force be removed, the force will act through the other half.

It will be seen from this, that in the sense in which the original question was meant, our answer was correct. Numerous individuals have thought that they could produce

perpetual motion by mounting two permanent magnets at the ends of levers, in such a way as to be attracted toward each other, and by their movement cause a thin sheet of insulating material to be interposed, thus cutting off the attraction, and causing the magnets to recede from each other by the action of gravity, or of a spring; this action in its turn removing the insulator, and allowing the magnets to again attract each other; thus producing a motion which would go on indefinitely, without the expenditure of external forces. Among all the many schemes to produce perpetual motion, this perhaps, seems, upon the face of it, to be the most feasible. But, as if nature deliberately calculated to defeat every plan to produce such a motion, she fails to furnish the required insulating substance; at least it never has been, and we believe never will be discovered.]

Device to Hold the Flap of a Planer.

Editor American Machinist:

In your issue of June 2d Mr. Frank H. Richards gives a way of holding down the apron in the tool-box of a planer, when necessary, which is good enough, but some of your readers may not wish to go to the trouble of putting the taper hole through the tool-box, and for their benefit I submit another plan.

A good solid gib is made of wrought-iron or steel fitting close enough to drive on underneath at one side of the tool; a very simple device, easily made and applied, and gibs the flapping apron of the tool-box down perfectly secure, unless it fits so loosely as to be liable to drop off—a thing I have never known to happen, even when a very light tap will drive it on or off.

Center Punch.

The Spiral Gear Wheel.

Editor American Machinist:

Mr. Lewis, in your issue for June 9th, states that the process of planing the perfect spiral gear tooth, which I credited to O. J. Beale, was in use by Wm. Sellers & Co. some time before it was published by Mr. Beale.

The first person to conceive an idea, especially if he reduces it to practice and achieves some decided result, is undoubtedly its inventor, and yet the credit of that invention will belong, and deservedly, I think, to the one who first publishes it and brings it into public notice.

The process was used, and a special machine for its application was made by the Pond Tool Co., then of Worcester, before Mr. Beale's articles attracted general attention to it, and it was certainly known in Europe more than ten years ago. A little agitation would probably show many cases of its use "before the war."

I took the liberty to call them Beale's spiral gears, because Mr. Beale was the first person known to me to publish a clear account of their proper construction. What is more to my purpose, Mr. Beale was the first to call attention to the fact that they did not agree with the Willis theory, then the undisputed theory of their action. Mr. Beale made a pair of spiral pinions, exactly alike, and called my attention to the plain fact that they would work together perfectly, although Prof. MacCord plainly states, and evidently proves, that such gears will not run together at all. It was this contradiction, this disagreement between theory and practice, that led me to study the subject, and to propose the theory that the contact was on the normal spiral section, rather than on the axial section.

I shall be much surprised if there fails to arise a score of persons who knew that theory years ago, but suppressed it for various satisfactory reasons. Geo. B. Grant.

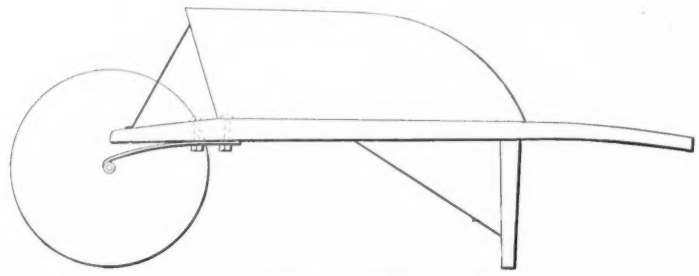
Boston, Mass.

A Spring Wheelbarrow.

Editor American Machinist:

I have just noticed an item, which seems to be floating around, to the effect that some one has "invented" (what an abused word that is!) a wheelbarrow having "elliptic springs, which greatly lessen the jar on the wheel, and also on the arms."

The writer of that item probably never worked much with a "monocycle," or he would have said arms first and wheel afterward. When I was a boy (of course this was a great many years ago) I had a desire to manufacture something, and so, during a vacation (between hoeing potatoes and corn husking), I made six wheelbarrows, which had springs under them like sketch enclosed. It is a very easy spring to make, and has the merit of being so placed that the frame of the "machine" will relieve it of any undue strain. Anyone who has used a barrow having springs, will have noticed that their arms retained their original length much longer than when using the springless variety.



Spring Wheelbarrow.

I will confess that the vehicles made as above didn't sell readily, owing to "boy construction," and my father, who had furnished the material, kindly allowed me to wear out several of them, one after the other, which enables me to speak more feelingly of the advantage of springs.

The arrangement here shown is most efficient, and would be largely used if its merits were known.

If the coming wheelbarrow has springs I don't want it to go "rattling down the ages" (though it won't rattle so much) credited to some new fellow who was born since the war. Sterling Elliott.

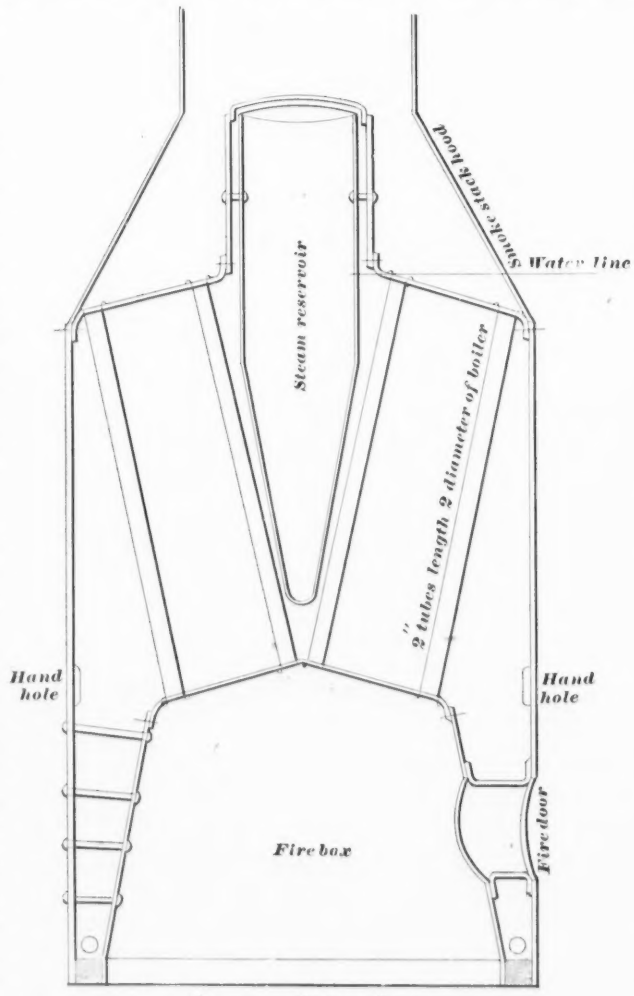
Newton, Mass.

Vertical Steam Boiler.

Editor American Machinist:

I have taken the liberty of sending you the enclosed sketch and description of a vertical steam boiler. It is not claimed that all of the features are new, but that they are a combination of features that have been used in different types of boilers. The results of over two years' service, under severe trials and circumstances, have convinced me that many of the objectionable features of the usual vertical boiler are remedied. It has demonstrated that this manner of construction will more nearly approximate a reliable, economical and serviceable boiler than any other form of this class. In planning this boiler the objects sought were protection of the crown, or lower tube sheet, a large amount of heating surface, large water space at the point of greatest heat, large dry steam capacity, complete submersion of the tubes, first cost, and last, though not least, a form that would admit of being easily cleaned—all of which are important factors in a steam boiler.

The simplicity of construction will need little explanation. It will be noticed that the fire box and tube or crown sheet are conical. The upper tube sheet is made on the same angle as the crown sheet, which will admit of the tubes being set at an angle; at the same time the tubes will be set square in both tube sheets. The result is that the products of combustion escaping will impinge more directly on the tubes. A glance will show that more space is gained between the tubes at the top than at the bottom, which will allow of free escape of steam, thereby preventing foaming or priming under heavy firing, as is the case with vertical boilers, especially with submerged tubes, as the space between the tubes is generally contracted towards the top.



Vertical Steam Boiler.

Dry steam capacity is a desirable factor in a steam boiler. It will be seen that the steam capacity of this boiler can be increased to suit any service, as the dome may be extended upward to any desired height. In addition to the steam drum, we have introduced a steam reservoir for the double purpose of increasing the steam capacity and the displacement of a large body of water found in the center of boiler, owing to the angular arrangement of the tubes. This steam reservoir is made of thin iron or steel, and made water-tight. It extends nearly to the top of the dome, and down to within a few inches of the crown sheet, and is secured in position by brackets or bolts. The service pipe should be introduced at the top, and extend into the reservoir a short distance. That will prevent water making its way to the engine. The steam will flow gently up in the large space between reservoir and dome, compared to the velocity through the service pipe.

The facilities for cleaning this boiler, I think, will be admitted as more perfect than other boilers of this class, as the lower tube head and fire-box being conical, scale and sediment will not collect to the same extent as on the flat tube sheet. Washing and scouring may be done more effectively.

The most important feature of any boiler is to have a large supply of water at the point of greatest heat. In this boiler the water space is gradually increased to the top of the fire-box, and continued up some distance, thereby insuring a large supply of water where it is most needed.

This boiler can be made not to exceed the cost of the usual submerged vertical tubular boiler. The facilities for repairs are fully equal to that boiler. Boilers made on this plan are especially adapted for small steamers, tug boats, or any service where rapid steaming qualities and small space is required. No patents, that I am aware of, prevent the use of this boiler. J. E. Jerrold.

One of the Largest.

Editor American Machinist:

An item on page 5 of the American Machinist for June 9th reminds one how frequently the "largest" casting, shaft, steam hammer, etc., are chronicled, and with what variety of weights and dimensions.

It is seven or eight years since Park Bro. & Co., of Pittsburgh, cast, in one piece, an anvil weighing one hundred and sixty tons. The steam hammer for which it was made had a falling weight, exclusive of steam pressure, of seventeen tons, with a clear stroke of nine feet.

It is quite possible that the above remain respectively, the "largest ever made in this country," although that claim has been made for a number of smaller examples of each.

A. B. Couch.

Philadelphia, Pa.

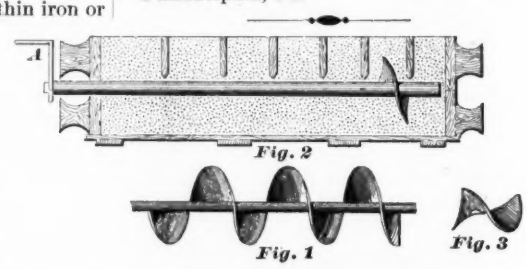


Fig. 2

Fig. 1 Fig. 3

Moulding an Elevator Screw.

By F. B. Shaffer.

Fig. 1 represents an elevator used in mills and tanneries. They are generally made in section, as seen at Fig. 3, and bolted together, lugs being cast on them for that purpose. The one shown at Fig. 1 is made solid, and as follows: The drag, after being placed in proper position, is filled with sand, and the shaft, with a segment of the screw securely fastened, is bedded in one end of the shaft, protruding from the end of the flask. The parting is made to the center of the pattern. The cope is then put on and rammed up, care being taken to have the sand very open, especially at the point where the top of the mould will be.

After the cope is rammed up then the real work begins. The shaft is turned by the handle at *A*, and at the same time, while turning, to prevent the screw from going the opposite way, it is necessary to pull on the shaft, and this must be done until the shaft is half way out, when it will cut its way out by simply turning the shaft. After the shaft has been worked out of the flask, the cope is lifted off, the mould is dressed, the gates cut and the thing is done.

These screws are made in sections 10 feet long, or any length desired; the diameter of the shaft is about 3″. The total diameter of the blade is 10″, and the thickness of the blade is $\frac{3}{8}$″ at the shaft, and $\frac{1}{8}$″ at outer edge.

Laying out Curves for Cams.

By Prof. A. T. Woods.

We may define a cam in general terms as a curved piece by means of which the desired motion of a driven point or piece is obtained from some simple motion of the driving piece. According to this definition, the teeth of gears may be considered as cams. For such teeth we can make use of several well-known geometrical curves, which can be readily described by rolling circles, etc., of we may establish graphically an infinite number of pairs of curves which will work

together. In the same way there are several well-known spirals which may be used for cam curves, where certain specific motions are required, while the number of possible cam curves is infinite.

In laying out cam curves, graphical methods are the most satisfactory, and of these the following is very generally applicable. The principles can be best explained by illustration. In Fig. 1 let C be the center about which a cam is to make a half revolution at constant speed and lift a point P from P to Q at a constant speed, C, P and Q being in a straight line. Describe a semi-circle $a\ d\ g$ about C as a center, with any convenient radius, and divide it into any number of equal parts. Divide the line $P\ Q$, along which the point is to be lifted, into the same number of equal parts. In the figure the number of parts is six. Draw radial lines from C through the points of division on the circumference $a\ b\ c$, etc. Then starting at a, when the cam has turned through $\frac{1}{6}$ of its half revolution, or the line $C\ b$ has moved to the position $C\ a$, the point P must be lifted $\frac{1}{6}$ of $P\ Q$, or to 1. Therefore lay off on $C\ b$ the distance $C\ 1' = C\ 1$ and the point $1'$ is a point on the cam curve, since it will be at 1 after the $\frac{1}{6}$ half turn. In the same manner, after $\frac{2}{6}$ of the half revolution $C\ c$ will have moved to the position $C\ a$, and the driven point must be lifted to 2. Therefore, laying off $C\ 2' = C\ 2$, we have a second point of the required curve. Continuing in the same way, the points $3'$, $4'$, $5'$ and $6'$ are found, and the curve $a\ 1'\ 2'\ 3'\ 4'\ 5'\ 6'$, drawn through them, is the curve which will lift the point P to Q at constant speed, as required. In practice, the drawing should be made to a large scale, and many more points found than in the figure.

It has been assumed that the center C is in line with $P\ Q$, as it would generally be in practice, but it is not necessarily so, nor is it necessary that the cam should revolve or vibrate at a uniform speed. To illustrate this, let, in Fig. 2, C be the center about which the cam is to turn and $P\ Q$ the line along which the point P is to be lifted. Draw a circle through P with C as a center. Assume that the point P is to occupy the positions 1, 2, 3, 4, etc., when the cam has turned through the arcs $a\ b$, $b\ c$, $c\ d$, etc. Draw a radial line $C\ P\ p$ through the point P. Then starting at the position shown in the figure, when the cam has turned through the arc $a\ b$ in the direction of the arrow, the point h' will be at h, and if we lay off the distance $h'\ 1' = h\ 1$ ahead of h' and measured on a circle about C as shown, the point $1'$ will occupy the position 1, and it is therefore a point on the required curve. When the cam has turned further through the arc $b\ c$, the point k' will be at k, and laying off a distance $k'\ 2' = k\ 2$, the point $2'$ will then be at 2, and we have a second point on the curve. Proceeding in the same manner the points $3'$, $4'$, $5'$ and $6'$ are found, and the curve drawn through these points is the curve required.

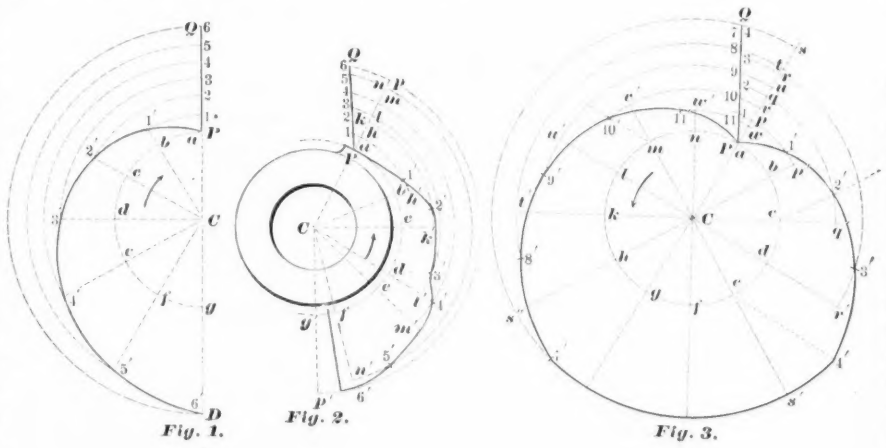
We will now apply this method to a cam which is to make complete revolutions. In Fig. 3 let C be the center about which the cam is to revolve uniformly once per minute, and lift a point along a line $P\ Q$ and control its descent. Assume that the point is to be lifted at a constant speed during 20 seconds, that it is to remain at rest during 15 seconds, and that it is to fall at a constant speed for 25 seconds.

Divide the circle drawn through P into twelve equal parts, each of which will therefore represent five seconds of time. As the time of lifting is 20 seconds, the arc $a\ b\ c\ d\ e$, equal to four of these parts, is the arc through which the cam turns, while P is being lifted. Divide $P\ Q$ into four equal parts as at 1, 2 and 3. Then, as in Fig. 2, lay off $p'\ 1' = p\ 1$, $q'\ 2' = q\ 2$, $r'\ 3' = r\ 3$ and $s'\ 4' = s\ 4$. The curve $a\ 1'\ 2'\ 3'\ 4'$ is the cam curve, which will raise the point P, as required. During 15 seconds, represented by the arc $e\ f\ g\ h$, the point is to remain stationary. Therefore lay off $s''\ 7' = s'\ 4' = s\ 4$ and the cam curve between $4'$ and $7'$ will be an arc of a circle drawn with C as a center. The descent of the point is to occupy 25 seconds, or the remainder of the revolution, and as it is to descend at constant speed, divide $P\ Q$ into five equal parts 7 8, 8 9, etc., corresponding to the arcs $h\ k$, $k\ l$, etc. Then laying off $t'\ 8' = t\ 8$, $u'\ 9' = u\ 9$, etc., we find points of the curve $7'$ $8'$ $9'$ $10'$ $11'$ and a, and thus complete the cam curve.

We have thus far considered the driven piece as a point. In practice it is necessary that a roller should be substituted for the point, and that side motion be prevented by guides, or by attaching the roller to the end of a vibrating arm. The use of a yoke in which the cam slides requires a somewhat different construction, and will be described later. If a roller is to be used the point P will represent its center, and the curves which have been constructed will be the *pitch lines* of the cams, which correspond to the pitch lines of gears. To find the actual shape of the practical cam, let the full line in Fig. 4 be the pitch line, found as in the preceding figures, and let $P\ a$ be a convenient radius for the roller. Then, with a radius equal to $P\ a$, and with centers on the pitch lines small distances apart, describe arcs toward the center of the cam, as shown in Fig. 4. These small arcs evidently represent successive positions of the roller as compared with the cam. For convenience we suppose the roller to move around the cam instead of moving the latter under the roller. If we now draw a curve which just touches these small arcs, or is tangent to them, it will be the curve according to which the actual cam should be made in order to produce very nearly the same motion, by means of the roller, as would be produced by the revolution of the pitch line under the point. The use of a roller is, however, apt to introduce errors. For example, suppose that the pitch line forms a point as at B, then it is clear that the point d, at which the two sides of the actual cam meet is at a greater distance from B than the length of the radius $P\ a$. Therefore the cam as made would not lift the roller as far as the pitch line would the point, by the difference between $B\ d$ and $P\ a$. It follows that the smaller the roller is made the more nearly the motion produced by the actual cam will agree with that of the pitch line and point. On the other hand, by attempting to use too large a roller, the motion which would be obtained may differ considerably from that of the pitch line. For example, in Fig. 4, suppose $P\ f$ to be the radius of the roller. Then proceeding by drawing arcs, as before, we find that they overlap so that the derived curve for the cam would have a corner at g, and that from f to g the motion would be very different from that required, as shown by the pitch line. This is, of course, an extreme case, and is given simply to illustrate the principle. Whether or not the size of roller selected in any case in practice is too great, can be very readily established by making a drawing to a large scale, and drawing a sufficient number of arcs to represent the successive positions of the roller.

When the direction of the motion of the driven point passes to one side of the center of the cam, as in Fig. 3, the direction in which the cam is to revolve may be of importance. In Fig. 3 the line $c\ 2'$ represents the position of the line $P\ Q$ when q' is at q. It will be seen that $c\ 2'$ is very nearly perpendicular to the curve at $2'$, and consequently there would be very little tendency to force the point P to one side or against the guides. Now suppose the cam to revolve in the opposite direction to the arrow. The line $m\ 10'$, which represents the position of $P\ Q$ when c' is at c, is inclined at a comparatively sharp angle to the curve at $10'$, and therefore there would be a considerable side pressure and consequent friction and wear. It follows that for cams which are to work in one direction only the construction of the lifting part of Fig. 3, as there shown, is preferable to the descending part of the same figure, or to the constructions shown in Figs. 1 and 4.

It is sometimes desirable, when a cam is to drive in both directions, that it should work between two rollers, and be always in contact with both of them. Fig. 5 shows the pitch line of a cam to work in this manner. The condition is that the distance between the two edges of the cam, measured across the center, must be constant and equal to the distance between the centers of the rollers. Let $a\ b\ c\ d\ e\ f\ g$ be the curve as laid out for the pitch line for the forward motion. Then $a\ C\ g$ must be the distance between the centers of the rollers. To find the radius $C\ b'$ lay off on $a\ C\ g$ $a\ h = C\ b$, then $h\ g = a\ g - C\ b$ is the length of $C\ b'$, to be laid off from C. In the same manner we lay off $a\ k = C\ c$ and $C\ c' = k\ g$, and so on, thus finding the points b' c' d' e' and f' on the curve for the backward motion. It follows from the construction that the distances $a\ g$, $f\ f'$, $e\ e'$, etc., are all equal, and that the curve as laid out for the forward motion controls the backward motion.



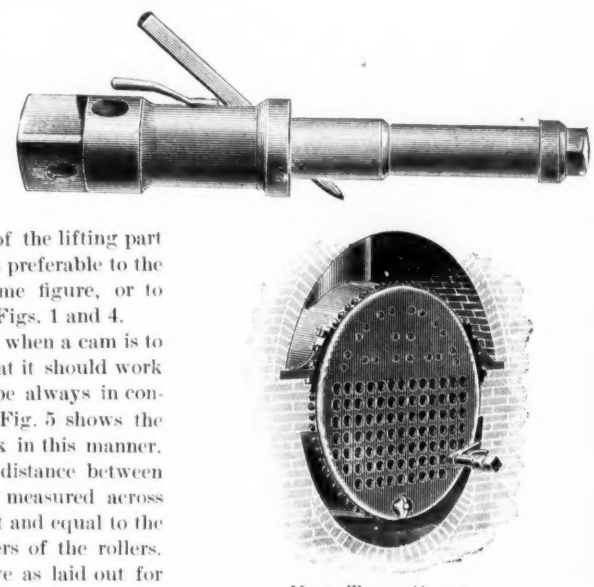
LAYING OUT CAMS.—SEE PAGE 6.

He Was Solid on the Question of Gravity.

A correspondent details—not for publication—his experience with the "man who sells oil." This man had a "low gravity" oil for sale, and he was way up on that feature. As the oil was to be exposed to considerable heat, our correspondent was anxious to know its flashing point. A query to this end stuck the vender of oil, but he was equal to the occasion. "The flashing point," said he, "has nothing to do with that oil, but I'll guarantee it has more low gravity to the gallon than any other oil on earth."

A New Tube Cutter.

The engravings herewith represent a new tube cutter, brought out by James R. Vance, Geneva, N. Y. The tool is made to take a washer at its inner end, to fit the inside of tube to be cut. Then the cutting tool, shown standing at an angle, is driven through the tube, locked in place, and the whole being turned around, cuts the tube off at one revolution.



NEW TUBE CUTTER.

The tube thus cut off is left in shape to weld to without the usual scarfing, and the operation is quickly performed.

Sheet Iron Bands for Locomotive Boiler Lagging.

It is the general practice to allow the lagging of a locomotive boiler to rest on wooden bands, strapped tightly around the barrel of the boiler. These bands often give considerable trouble by being burned, and sometimes are the cause of the destruction of the whole lagging. To overcome this difficulty Mr. J. H. Vreeland, master mechanic of the eastern division of the N. Y., L. E. & W. Railroad, hit upon an excellent device of making the bands of sheet iron. The form of these iron bands, when finished, resembles the form of ordinary channel iron; in fact, we may say they are miniature channel irons. They are, with their flanges, resting on the plates, clamped to the boiler, and thus presenting a smooth, flat surface, on which the lagging is allowed to rest. The expense of making and putting these iron bands on the boiler is less than that of wooden ones. They are made of the same kind of iron as is used for the jacket around the lagging, and often may be made from the iron jackets taken off old engines. In order to make these bands, strips of sheet iron are cut, whose width is such as to make the band, when finished, about one to one and a half inches wide, with flanges of sufficient depth to raise the outer surface of the bands above the rivet heads. These strips are then very easily and quickly rolled to the form of channel iron, and at the same time rolled to suit the diameter of the barrel. In order to allow for the difference of the outside and inside diameters of the bands, the flanges are somewhat crimped in rolling, but this in nowise detracts from the usefulness of the band; in fact, the crimping of the flanges adds to their stiffness. These bands have been in use on the N. Y., L. E. & W. Railroad for about six or seven years, giving great satisfaction. Not only is the danger of setting fire to the bands averted, but they will hold a portion of the lagging in position after another portion of the same has been burned, which cannot always be avoided. Experience has demonstrated the fact that, with the use of iron bands, the lagging will last longer, and give less trouble, than when the old-fashioned wooden ones are used.

We believe Mr. Vreeland deserves credit for this idea, as well as for many other improvements of his in labor-saving devices.

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Locomotive Driving Wheels Here and in England.

Along with the notion that there is something about a marriage with one's deceased wife's sister which makes it a grave crime, and other ideas which seem to other people to be peculiar, your genuine Englishman has always insisted that the "Yankee practice" of putting cast-iron driving wheels under locomotives was utterly indefensible, and the simple fact that an American locomotive is wrecked by the breakage of almost any other part of her, rather than by a failure of the cast-iron driving wheels, made no difference; it was wrong anyhow. American experience didn't count, and the only way to make an honest driving wheel was to forge it.

But now it seems, according to a writer in one of our English exchanges, that "many goods engines have lately been built for the Great Eastern Railway, with cast-iron wheels, having spokes of oval section, * * * and, as more than 300 have been made and used in active service for the past three years, on heavy coal and goods trains, they may be said to have answered every expectation." And, as if to make the matter worse, the article which contains this heretical statement was awarded a prize by the publishers of the *Mechanical World*, not, of course, on account of this statement, but in spite of it.

It is possible, however, that it was considered that this fault of the author was atoned for subsequently in the same article, where, in treating of methods of fastening tires onto driving-wheel centers, he says: "The Americans disdain any holding appliances, whatever, and boldly trust to shrinkage alone—a fallacious proceeding, as the wheel and rail are constantly acting as a rolling mill, to the discomfiture of the tire, which slowly increases in length under the process."

Now, it is with this practice, as it has been with the cast-wheel matter, a fact of no importance whatever, to English eyes, that the tires of American locomotives, though almost universally held in place by shrinkage alone, go right on giving entire satisfaction year after year, and that the supposed evil effects of this increase in length, persist in refusing to manifest themselves; it is wrong anyhow. The fact is, as referred to elsewhere in this issue, that there is, so far as we know, only one road in this country which makes use of anything else than shrinkage for holding tires, and in that case it is not claimed that they are any more secure, but the method is employed simply because it is easier to remove them *when worn out*.

But the fact that some cast-wheel centers have been made in England, and that it has been found that they do not break to pieces on the road, as it has always been declared they would, leads us to think that sometime it may possibly be discovered in England, that a driving-wheel tire, held by shrinkage only, will stay in its place. Americans have known it for a long time, but that makes no difference.

Honest Advertising.

The proprietors of a Sunday paper, published in Richmond, Ind., have written a letter to the New York *Herald*, which, it seems to us, they have every reason to be ashamed of. This letter, which was published in the *Herald* a few days ago, recites that they had made a contract for publishing an advertisement of the Tortilita mines to the amount of $30 cash. That when the bill became payable they were tendered $40 in stock of the mines, which, refusing to accept, they got nothing. They therefore write to the *Herald* to announce their opinion to the effect that the man with whom they made the contract is a "colossal fraud," a fact which, if they are at all intelligent, they ought to have known before they published the advertisements.

Every intelligent person knows that there are thousands of men in New York who are continually scheming to beat somebody out of their money, and that wild-cat mining schemes is a favorite method of doing it. They also know that there is always an abundance of capital here in New York to develop mines or to do anything else in which it can be satisfactorily demonstrated that there is a reasonable prospect of profits; and that New York men, instead of having to go to small country towns to get money to develop good mining property, are in the very place where such stock can be most readily floated upon satisfactory proof of its value.

This being the case, the fact that New York men are advertising such a scheme in the country papers may be taken as *prima facie* evidence that it will not bear the investigation of New York capitalists, and is a fraud.

If the proprietors of the Richmond *Sunday Register* did not know this, it does not speak well for their intelligence; if they did know it, and yet published the advertisement, it does not speak well for their sincerity and good faith with their readers, and the people of the town which supports their paper.

Richmond, while it is a town of considerable wealth, is also one of exceptional intelligence, and we do not imagine that any great amount of money was paid by its citizens for Tortilita mining stock, but for whatever business was done there in that line, if any, we do not see how the *Sunday Register* can be held blameless.

We hope the day is coming when newspapers will be expected to be honest, fair and sincere, all over—in the advertising columns as well as elsewhere; and when public opinion will not sustain papers which make a great fuss and parade about "exposing fraud" in their reading columns, and at the same time publish advertisements which bear upon their faces evidence of fraud and dishonesty. We have little sympathy with the proprietors in the loss of their $30, and wish that every paper which publishes advertisements, by which assistance is rendered in swindling its readers, would be unable to collect its bills for such advertisements.

Co-operative glass-making was inaugurated at Sandwich (Mass.) recently, by the formal opening of the works built by the striking employes of the Sandwich Glass Company. The fires were formally lighted by Rev. Father Griffin, amid much enthusiasm. It is the first co-operative venture in a town for 63 years identified with the glass-making industry. The new company is composed of intelligent young men, and likely to succeed.

A Mechanical Triumph.

To those who stop to think that to drive a steamship at a speed of twenty knots an hour requires the application of just about twice the power that it does to drive it at a speed of sixteen knots, the progress of the last few years in trans-Atlantic navigation is hardly less than marvelous. The last voyage of the Cunard steamship Etruria, from Queenstown to New York, is the fastest on record, being made in six days, one hour and fifty-five minutes, or at an average speed of nineteen and one-half knots an hour. This speed indicates that the power as applied to the propulsion of steamships has been just about doubled within the past fifteen years.

The great increase in speed of ocean steamships is a triumph of mechanical skill, and is mainly due to better construction of engines and boilers. Compounding, and the making of boilers capable of withstanding high pressure steam, has cut down the coal consumption to such an extent as to permit the use of engines of enormous power. Engines of equal power, and boilers sufficient to supply them, with coal enough for the work, could not have been floated under the old time low-pressure construction of engines. This progress, as before said, is purely mechanical. The value of high pressure steam has been known almost since the introduction of the steam engine; how to carry it safely and use it safely, especially on a steamship, was purely a mechanical problem. And so with high piston speed.

Looking at the matter in any possible light, the great increase in the speed of ocean steamships must be set down as a triumph of mechanical skill.

Lodge, Davis & Co. have gotten up a lithograph which might be called a mechanical work of art, if such a term were allowable. It represents a very beautiful young lady, having on a very handsome dress (not too extensive), and holding up to view a fringed Christmas card, with a picture of their latest lathe on it, while scattered around her are others of their productions. The background is horticultural, and in the dim distance is seen an engine and shafting; the whole forming a very pretty picture.

The Cincinnati Press Club has established permanent quarters at the Exposition Buildings, and will dedicate them Saturday evening, June 9. We have no doubt that members of the press will be welcomed. The enterprise of the Cincinnati Press Club is to be commended.

Imaginary Difficulties.

Of course we do not publish anything in our columns for which we deem it necessary to make any apologies, and we do not now propose to apologize for anything which has, or may appear in our columns; but we wish to call the attention of the many practical shop men who read our paper, to the fact that it is a great mistake to skip over an article treating of a subject in which they are interested, simply because it *looks hard*.

The writer is a shopman, and knows that there is among shopmen a tendency to conclude at once that any article which contains many figures, especially formulas, is dry, uninteresting and difficult, and only intended for the "book fellows."

As an instance, take the case of the articles now running on the Expansion of Steam, by Richard H. Buel. Now, to the many readers of the American Machinist who work at building one or more of the many forms of the steam engine, or at managing them, no subject of investigation can possibly be more profitable or more interesting than that of the principles governing the expansion of steam. And no study which they can possibly pursue will be more apt to contribute to their success in their chosen vocation. Mr. Buel is a well-known and recognized authority upon this subject, and in the treatment of it could undoubtedly go far beyond the comprehension of a great many of our readers. But in these articles he is making a point of simplicity and clearness, and any of our readers, interested in the subject, who are not following him, simply because they imagine his articles look hard, are making a mistake, and losing an opportunity of getting a good practical acquaintance with a subject which is somewhat intricate, and requires no small degree of skill and patience to make plain.

The fifth paper, for instance, published in our issue of June 9th, may have been skipped by some reader who ought to have read it, who could have read it understandingly if he had tried, and who would have been very much benefited by having read it.

Don't do this. Don't conclude that anything relating to a subject which you ought to understand is beyond your comprehension, until you have wrestled with it in earnest, and demonstrated it to be beyond your comprehension. If you always confine yourself to easy reading you will never learn very much. The mere act of studying something occasionally is beneficial, aside from the benefits arising from the possession of the knowledge gained by it.

It is very rare that anything appears in the columns of the American Machinist which cannot be understood by any one having a fair understanding of arithmetic, and ordinary intelligence.

Mr. Buel, as well as other writers who are contributing to our columns, deserve credit, and the thanks of the practical mechanics who read our paper, for the manner in which they make plain subjects, which are often treated in a very obscure and complicated manner; and their articles should not be skipped because they are not as easy as a b c.

Often what appear at first sight to be for-

midable obstacles in our path finally prove to be mere shadows, and vanish at the first touch.

QUESTIONS AND ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(301) W. H. L., Florence, N. J., asks how solder is recovered from old tin cans, and how the iron can be used for sash weights. *A.*The solder has been recovered by placing the cans upon perforated iron shelves, in a furnace which was heated to a temperature sufficient to melt the solder and cause it to drop through into receptacles below, but we believe it did not prove remunerative. Scrap tin is pressed by a plunger into a conical die, and thus made into lumps of comparitive solidity, which are then melted in a furnace, and cast into sash weights, the only kind of work it is fit for.

(302) F. H., New York, asks: What are the weights of the following cars? Eight-wheeled baggage car; eight-wheeled passenger car, and a twelve-wheeled sleeping car? *A.*—The weight of a standard baggage car with 36 inch tired wheels and equipped with steam heat is about 51,480 pounds. Weight of a 52 feet passenger car about 52,000 pounds. Weight of a 12-wheeled Pullman sleeping car, 86,300 pounds. To this we may add the weight of a Pullman parlor car, which is about 80,650 pounds. These weights do not include the load. Probably a fair average for the load will be about 8,000 pounds for each car.

(303) G. W. L., Glasgow, Scotland, writes: Will you kindly inform me of the highest working steam pressure in American locomotives? I have been told that 185 pounds is the regular working pressure on passenger trains of the N. Y., L. E & W. Railway. For the information of other engineers in the United States, I would say that 150 pounds is the highest working pressure allowed by the board of trade on any locomotive here. *A.*—The highest working pressure, until lately, on the N. Y., L. E. & W. railroad has been from 130 to 140 pounds. But on their new anthracite coal-burning locomotives, the highest pressure is 150 pounds. There are two roads in the United States which carry 180 pounds' pressure in some of their locomotives; one road which carries 175 pounds, and two roads, 160 pounds. Mostly all the other roads vary from 130 to 150 pounds' pressure in their locomotive boilers.

(304) A. B. A., Columbus, Ind., writes: *C C* on the enclosed sketch represents the frame of a car. Weight of car and load, 8,000 pounds; *D* a dynamometer made fast to car frame, *C* a chain attached to a spool *A* 5 inches diameter and to dynamometer *D*. Wheel of car 30 inches diameter. Car is supposed to be running 6 miles per hour when propelling power is detached, and spool *A* at the same time is engaged with axle. What draft will the dynamometer show when the car is stopped? What distance will the car run before stopping? And what will be the stress on the chain before the wheel *B* will slide on the track? *A.*—You have not given sufficient data from which the calculation can be made; we should also want to know more about the construction of the dynamometer, and the condition of the rails.

(305) J. A., Philadelphia, Pa., writes: I have had charge of small engines and boilers for a number of years, but I am very poor at figures. Will you please tell me how many horse-power my engine will develop. The cylinder is 8½ inches bore, 16 inches stroke, 100 revolutions, steam pressure 75 pounds. If you will set this in example form I may possibly understand it. *A.*—You do not state at what part of the stroke the steam is cut off, and consequently it is impossible for us to determine the mean effective pressure on the piston. But assuming that the mean effective pressure per square inch is 50 pounds, you may calculate the horse-power of your engine in the following manner: First find the cross-sectional area of the cylinder. This area is found by multiplying the diameter of the cylinder by the diameter of the same (in other words, square the diameter) and multiply this product by the constant number .7854; this last product will be the number of square inches in the cross-sectional area of the cylinder; hence we have $8\frac{1}{2} \times 8\frac{1}{2} \times .7854 = 56.745$ square inches. Multiplying the number of square inches in the cross-section of the cylinder by the mean effective pressure per square inch, we have, $56.745 \times 50 = 2837.25$ pounds, which is the total mean effective pressure on the piston. Now, your stroke is 16 inches, and therefore the piston, during one revolution, will move through a distance of $16 \times 2 = 32$ inches; reducing this distance to feet, we have $\frac{32}{12} = 2.66$ feet, and multiplying this distance by the number of revolutions per minute, we have, $2.66 \times 100 = 266$ feet, which is the distance through which the piston travels in one minute. Multiplying this distance (266 feet) by the total mean effective pressure (2837.25 pounds) we have $2837.25 \times 266 = 754708.5$ This product simply shows that the engine is capable of lifting 75470.15 pounds through a distance of one foot per minute. One horse-power is equivalent to lifting a weight of 33,000 pounds through a distance of one foot per minute, hence

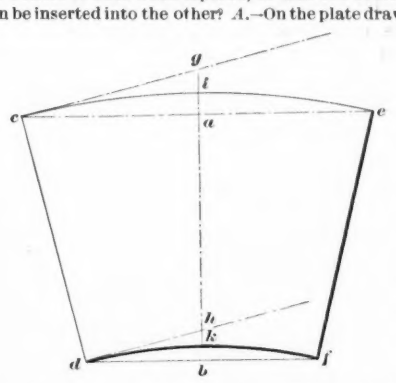
$$\frac{754708.5}{33{,}000} = 22.86,$$

total horse-power of engine. Part of this power is expended in overcoming frictional resistances, met with in imparting motion to the piston, cross-head and other moving parts. The amount of power required for this purpose is often equal to 15 per cent. of the whole power expended, hence the actual horse-power which the engine may develop will be equal to

$$22.86 - \frac{22.86 \times 15}{100} = 19.44,$$

actual horse-power. If you will refer to the answer given to question 257, in our issue of June 11, 1887, you will find that we have followed the rule there given.

(306) J. J. C., Middletown, Pa., writes: Would you kindly give me a rule for laying out iron for boilers or flues when tapered, so that one course can be inserted into the other? *A.*—On the plate draw



line *b i*, and on this line lay off the correct width *a b* of the plate. Through the points *a* and *b* draw lines *c e* and *d f* perpendicular to *a b*. Next find the circumference of the small end of the course, also that of the large end; thus: multiply the outside diameter, minus the thickness of the plate of the small end of the course by 3.1416; the product will be the circumference of the small end; and the diameter, minus the thickness of the plate of the large end of the course, will be the large circumference. Make the length of the line *d f* equal to the small circumference, so that one-half of the circumference will be on one side of the center line *b i*, and the other half of the circumference on the opposite side of the center line *b i*. In a similar way lay off the large circumference on the line *c e*. Join the extremities *c* and *d*, also *e* and *f*, by straight lines. Through the point *c* draw a line *c g* perpendicular to *d c*, and cutting the center line *i b* in the point *g*. Find a point *i* midway between *a* and *g*, and draw a curve by means of a flexible batten through the points *c i e*. Again, through the point *d*, draw a line perpendicular to *c d*, cutting the center line *i b* in the point *h*, and find a point *k* midway between the points *h* and *b*. Through the points *d k f* draw a curved line. The plate must then be cut to the curved lines *c i e* and *d k f*, and also to the straight lines *c d* and *e f*. A plate laid out in this manner is suitable for a course whose longitudinal seams are butt joints, because the lines *c e* and *d f* have been made equal to the length of the circumference of the ends of the course. If the ends of the plate are to lap over to make the seam, then the required amount for the lap must be added to the circumference *c e* and *d f*. 2. What is the lowest steam pressure required to drive a small engine with a cylinder 2"x3½", and a fly wheel 6 inches diameter at 100 revolutions per minute? *A.*—The steam pressure required depends on the work the engine has to do, but if you simply wish to run the engine at the rate of 100 revolutions per minute without doing any work, outside of the work performed in running the engine, you may probably need a pressure of five pounds per square inch of piston; but this depends on the weight of the moving mechanism of the engine, and the workmanship, and therefore may require a little more or less than five pounds' pressure.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

See Grant's Gear advt. on back page.

Link-Belting.

Send for Catalogue of Link-Belting.

Over 50,000,000 feet of Link Belt in use.

Link Belt Machinery Co., Chicago and N. Y.

Taper attachment on all lathes — Lodge, Davis & Co

Compound rest on all lathes — Lodge, Davis & Co.

Power cross-feed on all lathes — Lodge, Davis & Co.

Large hollow spindle on all lathes — Lodge, Davis & Co.

Automatic stop on all lathes — Lodge, Davis & Co.

See special ads. pages 15 and 16 — Lodge, Davis & Co.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

Lamb Knitting Machine Co., Chicopee Falls, Mass

Machine work and pattern making. Anderson Machine Works. Peekskill, N. Y.

The Improved Justice Hammer. Williams, White & Co., Moline, Ill., manufacturers.

The Best Upright Hammers run by belt are made by W. P. Duncan & Co., Bellefonte, Pa.

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

Light articles built to order by the American Sewing Machine Co., Philadelphia, Pa.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

Improved fine tools for mechanics, manf'd by L. S. Starrett, Athol, Mass. Send stamp for full list.

"Swift" Sight-feed Lubricator: no glass tubes: simple, reliable. Swift Lub'r Co., Elmira, N. Y.

Castings for small and medium sized vertical engines. Humphrey's Foundry, Bellefontaine, O.

Davis Key-Seating Machines, kept in stock, by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

Burnham's turbine wheel is sold at net price to mill owners. Catalogue free. Address York, Pa.

"How to Keep Boilers Clean." A book mailed free, by James E. Hotchkiss, 120 Liberty st., N. Y.

Selden packing, for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N. Y.

Brown & Sharpe Mfg. Co. have a line of machinery with S. A. Smith, 23 S. Canal st., Chicago, Ill.

Patents—Whittlesey & Wright, 705 8th st., N. W., Washington, D.C. Send for pamphlet and references.

Ice and Refrigerating Machines, 124 built, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.

For the latest improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago. Ill.

Engine lathes, hand lathes, fine tools, files and supplies for machinists and other metal workers. Frasse & Co., 92 Park Row, N. Y.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker st., Philadelphia, Pa.

Model Engines and Castings. Prices $3.75, $4.75 and $5.75. For descriptive circular apply to Montgomery & Co., 105 Fulton street, New York city.

Curtis Pressure Regulators, Curtis Return Trap, Curtis Damper Regulator. See June 9, p. 10. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

Machinists' supplies, brass goods, m'f'rs supplies polishing materials, all kinds wire, metals, etc., in any quantity. Jordan & Gottfried, 208 Canal st., N. Y.

For Best Return Steam Traps, Pressure Regulators, Positive-Acting Pump Govs., Back-Pressure Valves. T. Kieley, 11 W. 13th st., N. Y. Send for des'n.

Patent Att'y. R. G. DuBois, 916 F. st., Washington, D. C. Reliable service at reasonable rates. Send for 38-page pamphlet containing list of references.

The Holly Manufacturing Company, of Lockport, N. Y., will send, on application, their pamphlet illustrating pumping machinery and reports of duty trials.

How to remove and prevent scale in steam boilers at a cost of ten cents a week. Send postal for circular to Pittsburgh Boiler Scale Resolvent Co., Pittsburgh, Pa.

W. H. Hoffman, consulting engineer, 108 Liberty st., room 3, N. Y. Mechanical engineering in all its branches; working drawings for the transmission of power by steam, water, air and electricity.

Parties requiring milling machine or screw machine work furnished, in large or small quantities, please write to the manufacturers, E. E. Garvin & Co., 139, 141, 143 Centre st., New York City.

Contract work of all kinds executed promptly and on reasonable terms. Parties wishing gray iron castings in large quantities can make money by corresponding with Rawson Mfg. Co., Hornellsville, N. Y.

A practical treatise on the steam engine, by Arthur Rigg, essays on the principles involved in design and construction of fixed engines; 312 pages, with 96 plates. 4to, cloth, $10.00. E. & F. N. Spon, 12 Cortlandt st., N. Y.

For the manufacture of
Patented articles in line of machine work;
Specialties in fine light machinery;
Accurate cam cutting;
Address Wardwell S. M. Co., Woonsocket, R. I.

James D. Cardell & Co., 1900 Passyunk ave., Phila., Pa., boiler makers and sheet iron workers, m'f'rs of coils of wrought-iron pipe, return bends, etc. Address after June 15, Rising Sun Lane and North Penn. R. R. Boiler repairs promptly attended to.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines, and current practice in testing engines and boilers. Price $2, postpaid. Published by John Wiley & Sons, 15 Astor Place, New York.

"Binders" for the AMERICAN MACHINIST. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers, the full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUB'G CO., 96 Fulton st., New York.

The series of articles by J. G. A Meyer, on "Practical Drawing," now running in the AMERICAN MACHINIST, should be closely followed by every student. They commenced with October 23, 1886 issue, and up to and including June 2, 1888 issue, 51 articles have been so far published. Copies containing these articles, sent by mail to any part of this country or Canada, at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York.

"Modern Locomotive Construction," by J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, are attracting the attention of railway mechanics all over the world. Commencing with the June 27, 1885 issue, 65 articles have thus far appeared up to and including the May 26, 1888 issue. Copies containing these articles sent by mail to any part of the U. S. or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York.

MANUFACTURES.

H. Stokes is building a wagon factory at Darlington, Md.

E. F. Hanson will build a carriage factory at Belfast, Maine.

The Atlanta Wagon Company has been chartered at Atlanta, Ala.

The Wilmington, Del., Electric Light Company will extend their plant this summer.

The works of the Wallingford (Conn.) Wheel Company were recently destroyed by fire.

L. C. Moore, Trenton, N. J., is considering the removal of his wire works to Anniston, Ala.

Goddard Bros'. blacksmith and carriage shop, at Spencer, Mass., was recently destroyed by fire.

Austin, Flint & Day are building an addition 40x112 feet to their sash and blind factory at Manchester, N. H.

B. Freidburgh has been granted an electric light franchise at Kansas City, Mo., and will begin the erection of a plant at once.

The Birmingham, Ala., Hardware M'f'g Co. has been organized at Birmingham, Ala. H. M. Caldwell is president of the company.

The Potter printing press works, Plainfield, Mass., have just completed an order for six printing presses for the Canadian Government.

The City M'f'g Co. will build a cotton mill at New Bedford, Mass. The mill will be three stories, 112x206 feet; engine room 30x60 feet.

Thomas J. Stewart will build a large five-story carpet cleaning and storage works on Fifth and Erie streets, New York. Improved machinery will be used in the new building.

There is water works agitation in Oberlin, Kan.; Springfield, Ohio; Washburn, Wis.; Hoopeston, Ill; Washington, Me.; Brewer, Me.; Mt. Sterling, Ky.; Irwin, Pa.; Culbertson, Neb.; Crawford, Ga.; Seneca, S. C.

According to circular by "Ealy's Blue Book" the business of James Jenks & Co., manufacturers of engineers' supplies, has been sold to Felthousen & Sherwood, of Buffalo, N. Y., and the business will be removed to Buffalo.

The Parish Manufacturing Company, Chicago, Ill., has bought the entire plant, including patterns and patents of the North Star Iron Works Company, of Minneapolis, Minn. The business and works of the company will be moved to Chicago.

The stockholders of the Sagamore Manufacturing Company of Fall River, Mass., will build a new mill of 40,000 spindles, at a cost of $500,000. This will increase the capital stock to $800,000. The corporation has a surplus of $148,000, and for 16 years has paid 9 per cent. dividend annually.

The Electric Light Company, Taunton, Mass., has declared a 6 per cent. dividend and voted to add $10,000 to its capital, making it $80,000. The works will be enlarged at once, and new boiler, engine and two dynamos added, which will increase the lighting facilities by 300 incandescents and 50 arc lights.

The Duluth (Minn.) Iron and Steel Company have begun the construction of a blast furnace at Duluth. The plans for this plant have been prepared by Mr. John Birkenbine, the engineer of the company, and embrace a twin blast furnace plant. The furnaces are to be 16x75 feet, each equipped with three regenerative hot blast stoves. There will be twenty boilers and three blowing engines.

The stockholders of the Sagamore Manufacturing Company have voted to build a new mill at Fall River, Mass., of 40,000 spindles, at a cost of from $500,000 to $550,000, and to increase the capital stock from $550,000 to $800,000. The corporation has a surplus of $148,000, and in 16 years has averaged 9 per cent. a year in dividends. Twenty thousand seventy-six shares were in favor of building, and 963 against.

A newly formed company, with ample capital, has purchased Dr. Raub's patent for his central power engine, the first of which was constructed at the Grant Works some two years since, and which, it is claimed, has proven a very great success. It is said that ten of the engines will be built at the Grant Works as soon as the new company is ready to begin operations.—*Paterson* (N. J.) *Daily Guardian.*

Philip Rohan, secretary of the Rohan Bros. Boiler Manufacturing Company [St Louis, Mo.], returned last week from St. Paul, Minn., where he secured a contract for ten boilers, each 60 inches diameter and 20 feet long, for the new distillery of the St. Paul Distilling Company. The boilers will aggregate about 1,200 horse-power; the smoke stack will be made of boiler iron and be 8 feet in diameter by 120 in height.—*Age of Steel.*

C. R. Vincent & Co., 15 Cortlandt street, New York, is the name of a new firm which proposes to be the eastern representatives of a number of manufacturers, including the Skinner Engine Company and Ball Engine Company, of Erie, Pa., and the Wainwright M'f'g Co., of Boston. T. C. Wood, formerly of the firm of Skinner & Wood, Erie, Pa., is the "Co." Mr. Vincent also was formerly with the same firm, and afterwards with the Skinner Engine Company.

The Sprinfield (Mass.) Printing and Binding Company, with a capital of $100,000, was organized recently, and the following officers were elected: President, Louis H. Orr; clerk, T. M. Brown; treasurer, W. H. Nevins; Directors, L. H. Orr, H. S. Hyde, T. M. Brown, A. J. Wright and Elisha Morgan. No time will be lost in moving into the Morgan building, between Harrison avenue and Hiiman streets, which was engaged by the former Springfield printing company.

A mechanical genius of Fort Worth has invented a refrigerator and cooler which possesses great merit, and for which he has applied for a patent. The fact coming to the knowledge of several of our enterprising citizens, they have taken the matter in hand and propose to organize a company to manufacture these coolers and refrigerators in Fort Worth. There is great demand for them, and Fort Worth is certainly situated to supply the demand. It has not been decided yet what the capital stock of the company will be. Unless all signs fail, Fort Worth will, before a great while, be a manufacturing center.—*The Gazette* (*Fort Worth, Texas*),

Machinists' Supplies and Iron.

New York, June 7, 1888.

Iron—American Pig—We quote Standard Lehigh brands $18 to $18.50 for No. 1 X Foundry; $17 to $17.50 for No. 2, and $15 75 to $16.25 for Grey Forge. Outside brands are lower, but so irregular in price as to make quotations very difficult.

✲WANTED✲

"Situation and Help." Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

Wanted—Men to examine S. S. planes; see p 11.

Situation wanted by pattern maker, accustomed to general machine work. R. S., Am. Machinist.

Wanted—Steady situation by a good practical machinist. Address S. J., care Am. Machinist.

Wanted—Position by a young man; good machinist. Address Box 362, Chicopee, Mass.

A Norwegian engineer seeks employment as draftsman; knows English. Box 102, Am. Machinist.

Wanted—Competent machinists on lathes and planers. The Pond Machine Tool Co., Grant ave., Plainfield, N. J.

First-class machinist and toolmaker wants work in N. Y. City or vicinity; capable of taking charge of men. Capable, Am. Machinist.

Wanted—Position as foreman or general manager of boiler shop; 20 years' experience; first-class references. Address Mechanical, Am. Machinist.

A young man wishes a permanent situation as mech'l draftsman; is a machinist and a Technical school graduate; best ref. Box 101, Am. Machinist.

Wanted—Foreman, American, for brass foundry; thirty furnaces; must thoroughly understand mixing of metals and be capable of handling men. H. W., Am. Machinist.

Wanted—A position as draftsman, by one shortly in this country; speaking German and but little English; capable of making copies or drawing to sketches. Address M. S. S., Am. Machinist.

Wanted—In the interior of Pennsylvania, for about two months, a draftsman familiar with locomotive work. Address, stating experience and salary expected, O. B., P. O. Box 262, New York City.

Wanted—Situation as foreman of boiler works; has had large experience on every variety of work, and the management of workmen; knows how to work men and tools up to their full capacity; can make drawings and estimates. First-class references from former employers in above capacity. Address, B. M., Am. Machinist.

Wanted—By a thoroughly successful superintendent of machine shop and foundry, and practical machinist of twenty years' experience, a change after Aug. 1, 1888; now has entire management of plant of 100 men in New England; best of reference; would accept situation as superintendent or as foreman of machine shop at reasonable figures. George H., Am. Machinist.

✢ MISCELLANEOUS WANTS. ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion.

Crescent steel tube scrapers are unquestionably the best. Crescent Mfg. Co., Cleveland, Ohio.

Crescent boiler tube cutter, for setting new and removing old tubes. Crescent Mfg. Co., Cleveland, O.

Wanted - Parties having machinery specialties to build, to correspond with. Box 75, Am. Machinist.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

Correspondence solicited with parties having machine or foundry specialties to build. Honesdale Iron Works, Honesdale, Pa.

Adamantine adhesive for making steam joints; stops leaks in boilers, stops pitting. Chas. Barnes & Co., Cincinnati, Ohio.

Wanted—To buy second-hand lathes, planers and shapers of all sizes; must be cheap and in good order. Fosdick & Plucker, 6th and Culvert streets, Cincinnati, Ohio.

For Sale—My patent flue cleaner, or would like to get it man'f'd on royalty; see cut in this paper, June 9, 1888. For furtner information address E. D. Weston, Jackson, Mich.

For Sale—In Birmingham, Ala., machine shop, equipped with best make of new mach'y; a bargain for most any manufacturer with moderate capital. Opportunity, Am. Machinist.

Machine shop and foundry for sale, to rent, or partner wanted. Very good location, with two railroads running by shop; poor health the cause of this offer. Address G. R. H., Am. Machinist.

August C. Christensen, M. Am. S. M. E., 24 State st. (Battery), N. Y.; 463 Henry st., Brooklyn. Working drawings and superintending the building of machinery; steam, pumping and gas engines indicated.

100 horse-power engine, Fitchburg make, 15x30 cylinder; cost $3,000; No. 7 Berryman heater; 50 ft. 5 in. wrought iron exhaust pipe; 60 ft. 12 in. belting; one six-foot driving pulley, 12 in. face; whole lot cost $3,700; will be sold for $1,500. H. E. Parson, 35 Liberty st., New York.

Ernest W. Naylor, consulting engineer and draftsman, plans and estimates for all kinds of hydraulic flanging, bending, forging, and other presses; hydraulic shearing and punching machines, jacks, capstans, cranes, hoists, lock gate and sluice machines; Bessemer and steel plant ingot cranes; center cranes, blowing and rail mill engines, etc.; etc.; fixed and portable hydraulic riveting plant; pumping engines and accumulators, etc., etc. Offices J. & K., 149 Broadway and Liberty st., N.Y.

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LATHES PLANERS DRILL PRESSES
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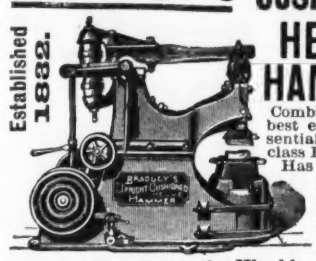

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Established 1832

With a manufacturing experience of over half a century, we recommend these machines to be the best, simplest, most durable and combining all the essential elements.

For hard coal or coke. Indispensable in all shops to keep Bradley's Cushioned Hammers and men fully employed and reduces cost of production.

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ONE HALF TIME and LABOR saved by using this solid, strong, durable, firm hold, quick-working Lever (Not Screw) Vise. Has improved Taper-Pipe and other attachments. Sold by the trade. Send for circular.

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95 Chambers Street, New York.
Successors to Melvin Stephens.

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EMERY WHEELS and GRINDING MACHINES

For Circulars address THE TANITE COMPANY, STROUDSBURG, MONROE CO., PA.

Or H. A. ROGERS, 19 John St., N. Y.

"Star" Foot Lathe Swings 9x25 in.

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Catalogue Free of all our Machinery.

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Over 35,000 in Use.

Crescent Gauge. Flat Bar Gauge.

JAS. A. TAYLOR & CO.

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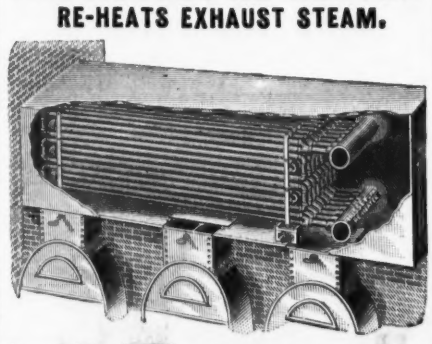
RE-HEATS EXHAUST STEAM.



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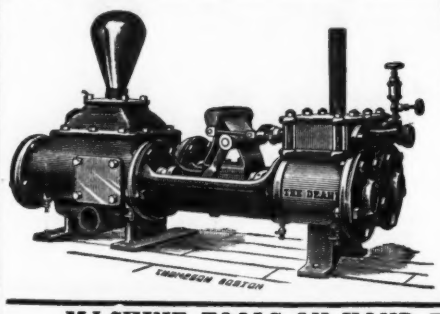

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PUMPS
FOR ALL PURPOSES.
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15in., 24in. and 25in. Pillar Shapers. 15in. and 20in. Traverse Shapers. 10in., 16in. and 22in. Planers. 18in. x 6, 8, 10 or 12ft. Engine Lathes, (New Pattern.) 10, 12 and 15in. Speed Lathes. Larger size Planers at short notice. Also our Forming Lathe for special brass work. A few 2d hand tools also on hand.

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You now find so much CRESCENT STEEL used in large shops, where results are closely watched, is on account of the superior quality and quantity of work done by tools made from it.

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CRESCENT STEEL WORKS, Pittsburgh, Pa.
Eastern Office and Warehouse, 490 Pearl St., New York.

Sebastian, May & Co.'s Improved Screw Cutting FOOT AND LATHES POWER

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Builders of Steam Pumps, Vacuum Pumps, Vacuum Apparatus, Filter-press Pumps, Air Compressors, etc.

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Nice Castings, Smooth and True to Patterns, of very best brands of Pig Iron.
CASTINGS IN QUANTITY AT FAVORABLE PRICES.

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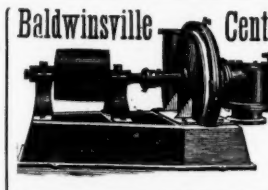

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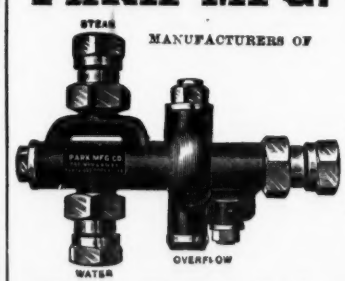

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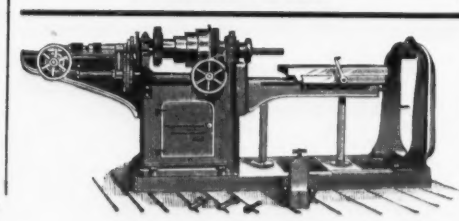

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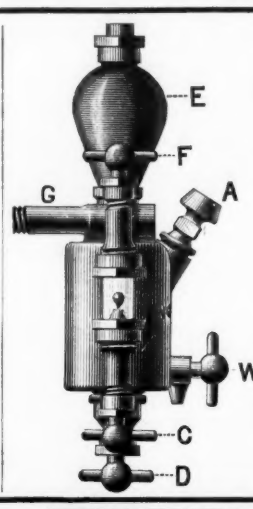

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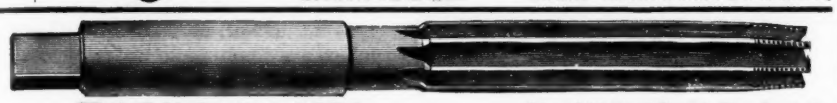

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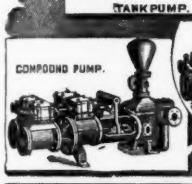

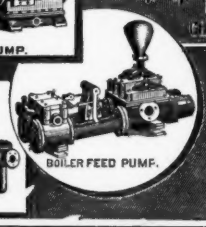

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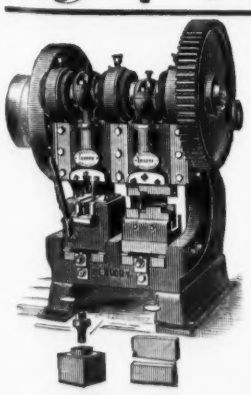

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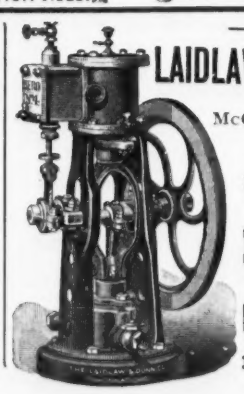

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5	1¼	.80	14	4	2.10
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7	1½	.95	16	5	3.25
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1 Set to 2 in.		7.80	Full Set		31.10

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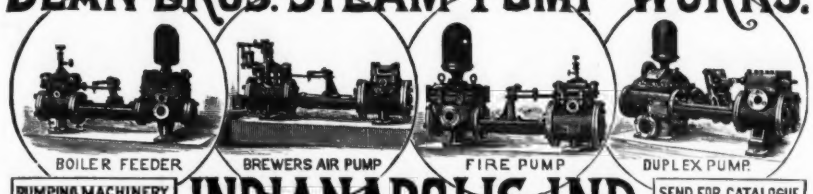

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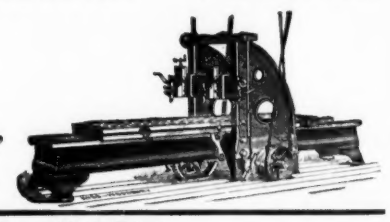

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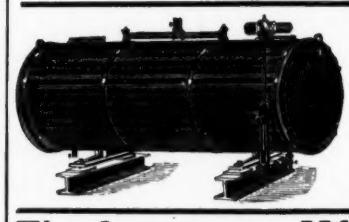

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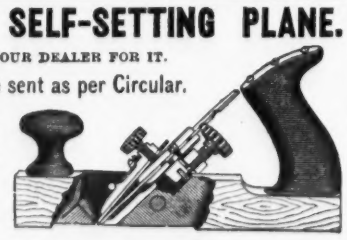

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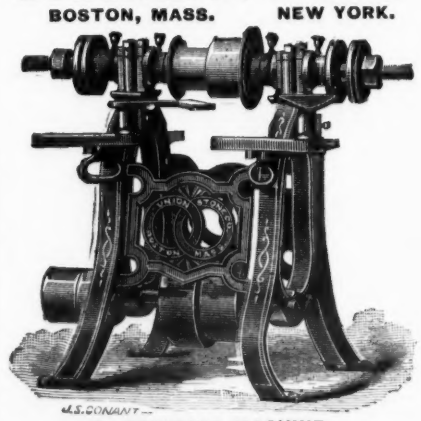

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1½ in. Steel Arbor. Takes Emery or Corundum Wheels to 20" diameter. Of this style we have six sizes, to suit different classes of work, from ¾" to 2½ " Arbor.

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SURFACE CONDENSERS

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High Range of Vacuum assured

REGULAR IN MOTION DURABLE AND COMPACT

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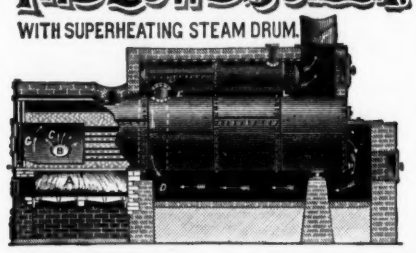

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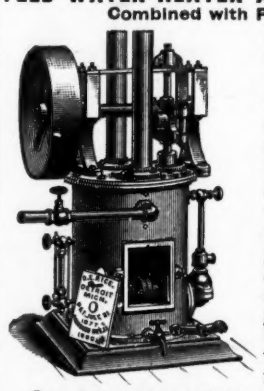

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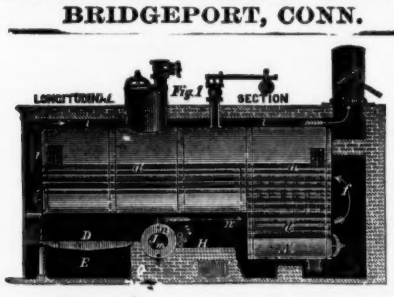

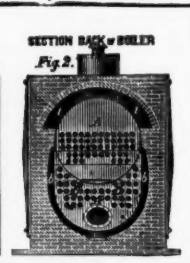

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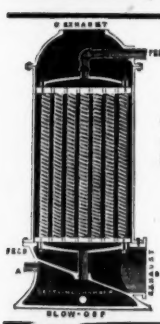

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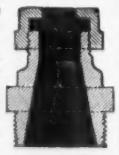

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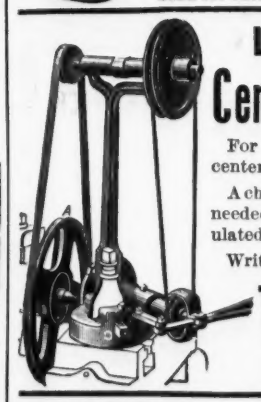

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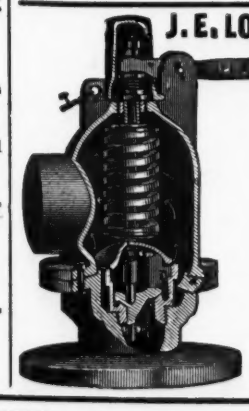

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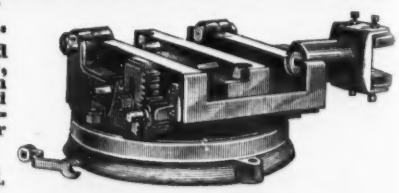

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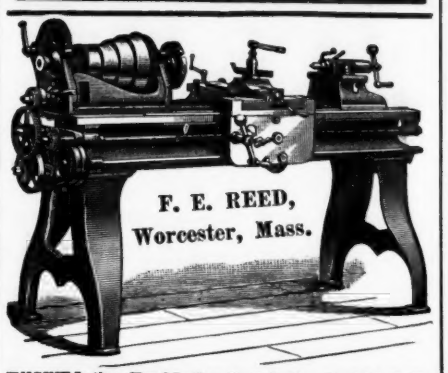

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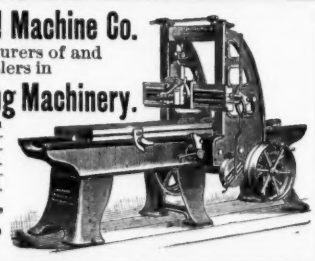

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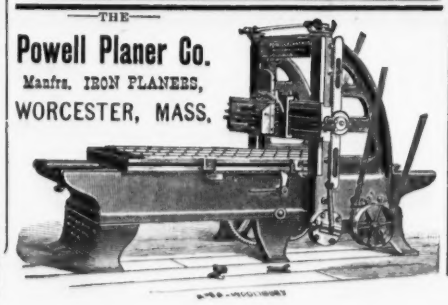

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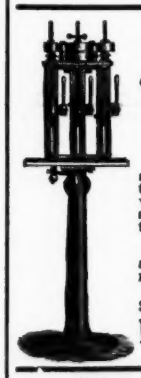

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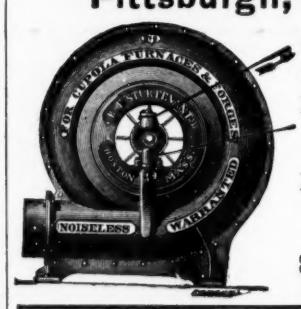

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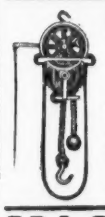

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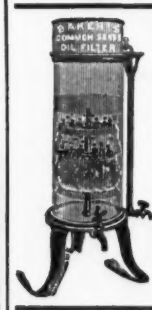

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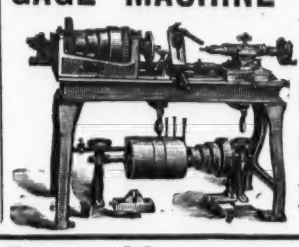

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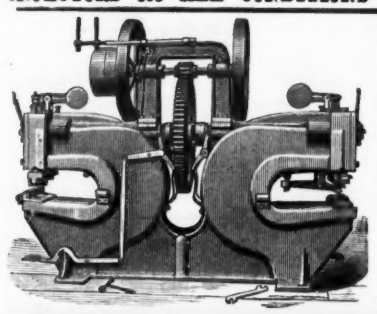

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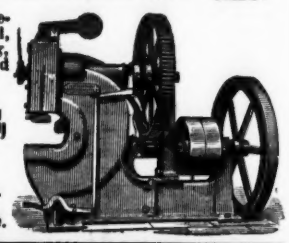

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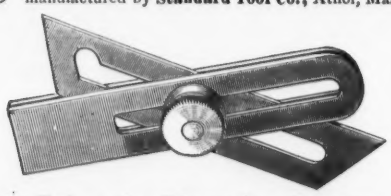

Any Tool we make will be sent by mail or express to any address, all charges prepaid, on receipt of price.

COPELAND
OIL-BURNING STEAM ENGINE.

Water, Steam, Fire. Entirely and reliably
AUTOMATIC.
No Engineer required. Consumes about one-third as much oil as other oil-burning engines. Weight of 2 H. P. engine, 100 pounds.
GENERAL AGENTS:
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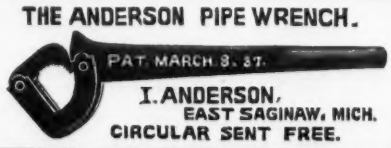
Chicago: COPELAND S. E. CO., 199 S. Clark St.
St. Louis: M. M. BUCK & CO.
NORTHROP MFG. CO.,
117-121 N. Front St., Camden, N. J.

THE ANDERSON PIPE WRENCH.



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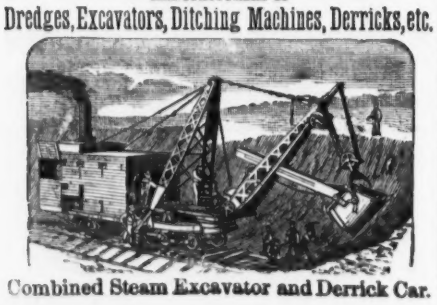
CIRCULAR SENT FREE.

WM. BERKEFELD'S FOSSIL MEAL COMPOSITION.

THE BEST
Non-Conducting Covering for Steam Pipe and Boilers.
The only genuine Fossil Meal. Sold in bags of 110 lbs. each. Beware of imitations. Send for circulars.
Trade-mark. W. B. C.
Fossil Meal Co., 48 Cedar St., N. Y.
A. GIESE, Sole Proprietor.

OSGOOD DREDGE CO., Albany, N. Y.
RALPH R. OSGOOD, Pres. JAMES H. BLESSING, Vice-Pres. JOHN K. HOWE, Secretary and Treasurer.
MANUFACTURERS OF
Dredges, Excavators, Ditching Machines, Derricks, etc.



Combined Steam Excavator and Derrick Car.

MACHINE TOOLS
For Immediate Delivery.
1 42 in. x 18 ft. bed, treble-geared **LATHE.**
1 32 in. x 18 ft. bed, treble-geared "
1 36 in. x 36 in. x 9 ft. stroke **PLANER.**
1 40 in. x 36 in. x 12 ft. stroke **PLANER.**
1 48 x 48 x 22 ft. stroke **PLANER.**
These planers are held at very low prices.
1 72 in. Pulley **TURNING MACHINE.**
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1 42 in. Cam Milling Machine for Printing Press Cam.
THE NEWARK MACHINE TOOL WORKS,
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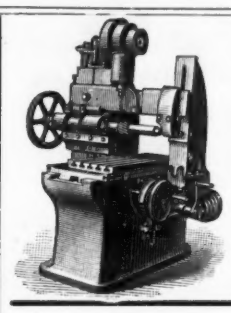

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BUILDERS OF
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FOR
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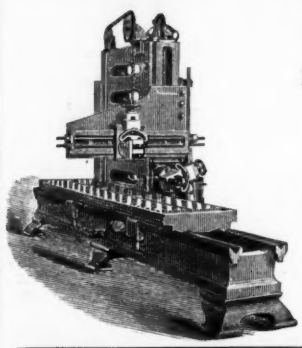

THE OPEN-SIDE IRON PLANERS.
For Accuracy and Dispatch in the performance of the regular line of planer work, these tools are guaranteed to be unexcelled by the ordinary style of planers of the very best makes.
For a large class of the Extra Wide and Heavy Work, requiring the Large and Costly Planers of the regular type, the Open-Side Planers are invaluable.
The Sellers Spiral Planer Motion is employed on these planers.
DETRICK & HARVEY, Manufacturers,
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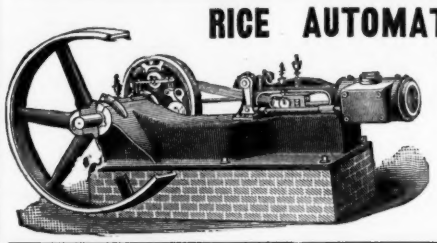

Self-Contained. Sensitive Governor. Balanced Valve. High Speed. Stationary Oilers. Best Economy
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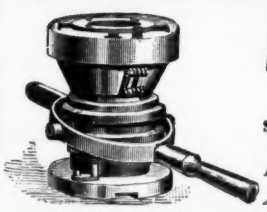

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Manufacturers of
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Single & Double Automatic Boltcutters,
Cutting from 3-8 in. to 6 in. diameter.
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Send for Catalogues and Discounts.
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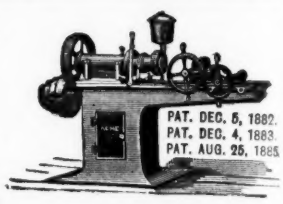

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Chucks, Drills, Reamers, Screw-Plates, &c.
RAILROAD SUPPLIES.
✣ NEW CATALOGUE NOW READY. ✣
PALMER, CUNNINGHAM & CO., L'd.
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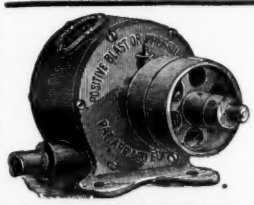

POSITIVE PRESSURE OR BLAST BLOWER.
1. They are Cheaper than any other.
2. They are Equal in Capacity to larger ones of other makes.
3. Very Little Power is required to run them.
4. Exceedingly Simple in Construction.
5. Give a Positive Blast, and will drive air through the smallest aperture.
6. For Blow Pipe or Furnace they have no equal.

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GESSWEIN MACHINE CO.
OFFICE, 39 JOHN STREET, NEW YORK.

STEEL CASTINGS
From 1-4 TO 15,000 lbs. WEIGHT.
True to Pattern, sound, solid, free from blow-holes and of unequaled strength.
Stronger and more durable than iron forgings in any position or for any service whatever.
40,000 CRANK SHAFTS and 30,000 GEAR WHEELS of this steel now running prove this.
Cross-Heads, Rockers, Piston-Heads, etc., for Locomotives.
STEEL CASTINGS of every description.
Send for Circulars and Prices to
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THE CAMPBELL MACHINE CO.
is very thoroughly equipped to do first-class machinist work, in experimenting, model making, and building of all kinds of fine light Machinery and Tools.
Superior Workmanship at Reasonable Prices.
Address CAMPBELL MACHINE CO.,
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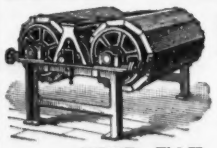
Exhaust Tumbling Barrels.



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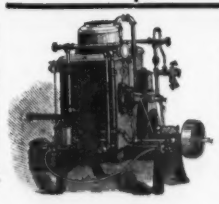
SEND FOR LIST OF USERS.
Evansville Spar Mining Co., Evansville, Ind.



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For Printers, Steam Yachts, pumping water, sawing wood, making ice-cream, Carpenters, Mechanics. 1 to 5 H.P. Fuel, Kerosene. No dust. Automatic in fuel and water supply. Illustrated Catalogue free. Mention AMERICAN MACHINIST.
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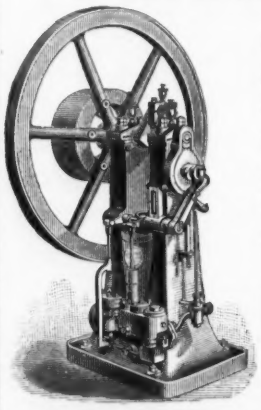
KORTING GAS ENGINE.
1 to 100 Horse Power.



The Korting Gas Engine is placed upon its merits and underfull guarantee to every purchaser.
CATALOGUES on APPLICATION.
KORTING GAS ENGINE CO.,
LIMITED.
60 BARCLAY STREET,
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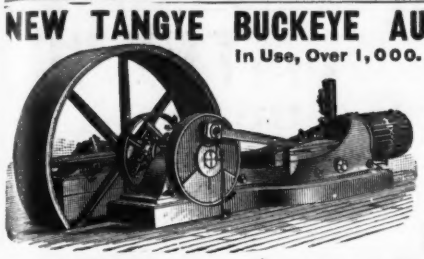
NEW TANGYE BUCKEYE AUTOMATIC CUT-OFF ENGINES.

In Use, Over 1,000.

25 to 1,000 H.P.



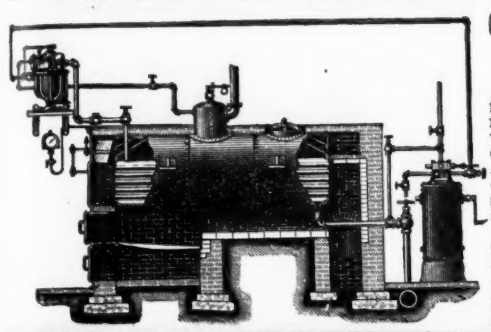
These engines are the combined result of long experience with automatic cut-off regulation, and most careful revision of all details. They are designed and constructed for heavy and continuous duty at medium or high rotative speeds. Highest attainable Economy in Steam Consumption and superior regulation guaranteed. Self-contained Automatic Cut-off Engines 12 to 100 H.P. for driving Dynamo Machines *a specialty*. Illustrated Circulars, with various data as to practical Steam Engine Construction and performance, free by mail. Address, BUCKEYE ENGINE CO., Salem, Ohio.

SALES AGENTS: W. L. SIMPSON, 301 TELEPHONE BUILDING, 18 CORTLANDT STREET, N. Y. { N. W. ROBINSON, 154 Washington St., Chicago, Ill. ROBINSON & CARY, St. Paul, Minn.

KENSINGTON ENGINE WORKS, LIMITED, PHILADELPHIA.

Sole Licensees and Manufacturers for New Jersey (South of Trenton), Eastern Pennsylvania, Delaware, Maryland and Virginia.

BLESSING'S WATER CIRCULATOR AND PURIFIER



Guaranteed to Absolutely Prevent Formation of Scale in Steam Boilers.

Automatically takes water from the boiler, filters it, and returns it in pure condition, thus removing scale-making impurities from the water, and maintaining a free and steady circulation. Combines the well-known Albany Steam Trap with a Filter of novel construction, which has no rival in point of simplicity, facility for cleaning, and assurance against clogging of sand valve.

Send also for Circulars of Albany Steam Traps, Blessing's Renewable-Seat Stop and Check Valves, Pump Governors, Water Circulators and Purifiers, etc.

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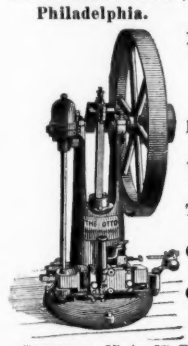

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COMBINED "OTTO" GAS ENGINES AND PUMPS.
COMBINED "OTTO" GAS ENGINES AND DYNAMOS.

Consume 25 to 75 Per Cent. Less Gas than ANY other Gas Engine doing the same work.

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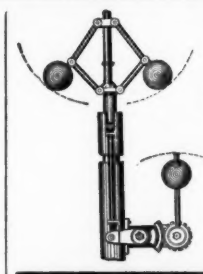

As attached to the Governor of a Corliss Engine, made only by

Remington Machine Co.,

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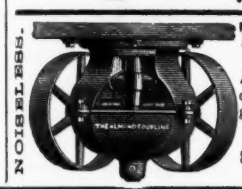
Wilmington, Del.

The Almond Coupling



A NEW quarter turn motion to replace quarter turn belts and bevel gears.

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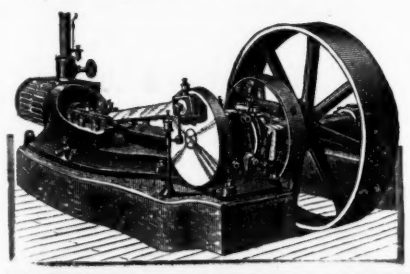

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BOILERS, ETC.

Complete Power Plants Furnished and Erected.

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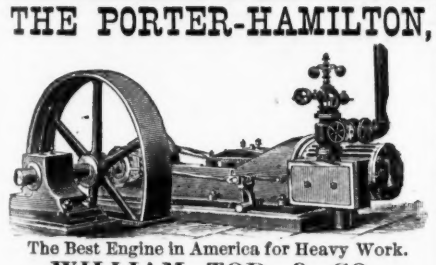

The Best Engine in America for Heavy Work.

WILLIAM TOD & CO., Youngstown, Ohio.

MACHINERY ON HAND.

16 in. x 42 in.	Planer,	Bridgeport,	new.
20 in x 4 ft.	"	New Haven,	fair.
22 in. x 4 ft	"	Ames,	good.
22 in. x 4-5 and 6 ft.	"	Powell,	new.
24 in. x 6 ft.	"	Powell,	"
26 in. x 7 ft.	"	Brettel,	"
27 in. x 4 ft.	"	Windsor,	cheap.
30 in. x 8 ft.	" each	Atherton, Powell & H. & P.	new.
36 in. x 12 ft.	"	Niles,	good.
38 in. x 14 ft.	"	Enterprise,	cheap.
60 in. x 12 ft.	"	G. W. & W. Screw,	good.
54 in. x 12 ft.	"	Bement,	fair.
11 in. x 4 ft.	Engine Lathe,	Prentice,	good.
12 in. x 6 ft	"	Young,	new.
13 in. x 6 ft.	"	Ames,	"
14 in. x 6 ft.	"	Blaisdell,	"
14 in. x 7 ft.	"	Bogart,	"
14 in. x 6 ft	" Gap Bed,	S. M. & Co.,	"
15 in. x 6 and 8 ft.	"	Porter,	"
16 in. x 6 ft.	"	Ames,	A 1.
16 in. x 6 and 8 ft.	"	Blaisdell	new.
16-20 in. x 6-8-10 & 12 ft.	"	Bridgeport,	"
18 in. x 8-10-12 ft.	"	Different Makes,	"
20 in. x 8-10-14ft.	"	Different Makes,	"
20 in. any length Bed	"	Bridgeport,	"
22 in. x 12 ft.	"	Niles,	heavy.
23 in. x 8-10 12 & 14 12	"	Br dgeport,	new.
26 in. x 12 ft.	"	Wright,	new.
28 in. x 6 ft.	"	Fifield,	"
36 in. x 14 ft.	"	Fifield,	"
2 in. Drill		Davis.	"
20-23-25-28 inch Drills		Blaisdell,	"
20-25-28-32 inch	"	C. & S.	"
5 ft. Am. Universal Radial Drill,			"
No. 1 and 3 Universal Miller,		Brown & Sharpe,	"
No. 1-2 and 6 Plain	" "	" "	"
No. 1 Universal Grinder,		" "	"

Cold Rolled Shafting in Stock. Send for list. Write for what is wanted.

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IMPORTANT!

We are now placing on the market 17", 24", and 27" Engine Lathes, same design and construction as our celebrated 19" and 21" Lathes.

We shall produce them in large lots, in order that we may be able to offer them at the popular prices that induced the unprecedented sale of our 19" and 21" Lathes.

Weight of 24" with 10 ft. bed, 5200 lbs.

Weight of 27" with 10 ft. bed, 6500 lbs.

We furnish, without extra charge, *Taper Attachment, Compound Rest, Automatic Stop for Carriage, Pulley Rest, Etc.*, in addition to regular attachments.

WRITE FOR PRICES, WITH CUTS AND DESCRIPTIONS.

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Machine Tools,

159, 161, 163 and 165 EGGLESTON AVE.,
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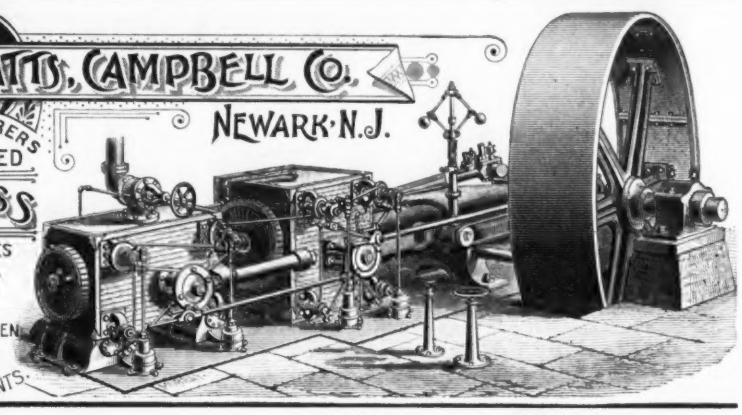
(See our advertisement on last page.)

THE WATTS, CAMPBELL CO.

MANUFACTURERS OF IMPROVED CORLISS STEAM ENGINES IN FULL VARIETY

NEWARK, N.J.



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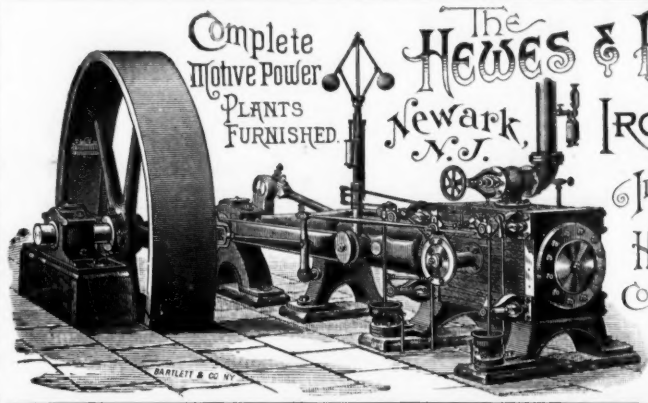
The Hewes & Phillips Iron Works

Newark, N.J.

Complete Motive Power Plants Furnished.

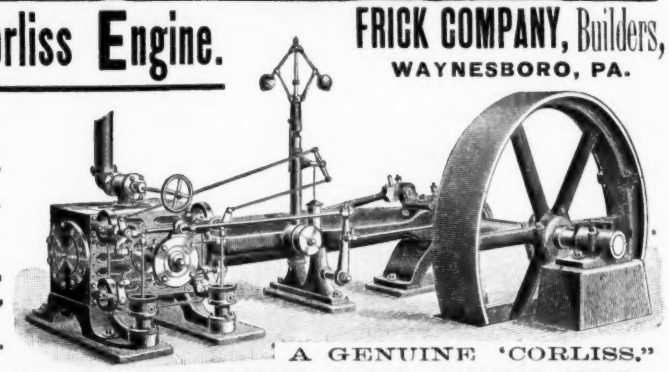


Improved CORLISS ENGINES. High Pressure. Condensing and Compound TUBULAR BOILERS.

GEO. A. BARNARD, AGENT.

Eclipse Corliss Engine.

FRICK COMPANY, Builders, WAYNESBORO, PA.



Non-Condensing, Condensing, Compound.

40 TO 1,000 H.P.

Send for Circulars.

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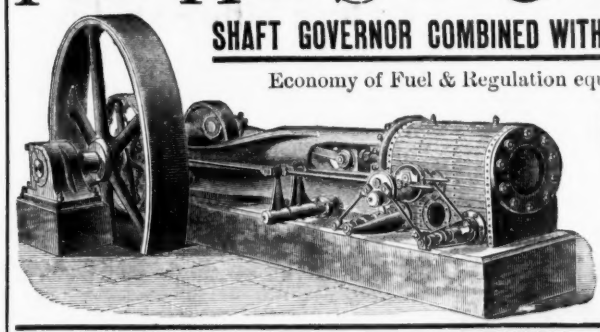
A GENUINE 'CORLISS.'

M. J. TIERNEY, 20 NORTH CANAL STREET, CHICAGO, WESTERN AGENT.

PAYNE HIGH SPEED CORLISS ENGINE.

SHAFT GOVERNOR COMBINED WITH CORLISS WRIST-PLATE.

Economy of Fuel & Regulation equal to anything in use.



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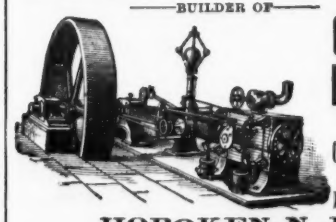

CORLISS Engines, AIR Compressors and BOILERS.

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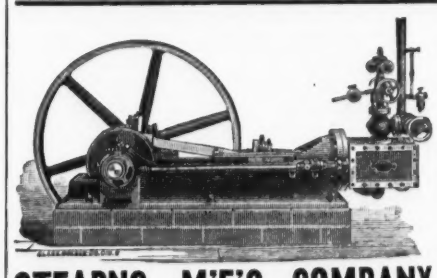

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ENGINES from 15 to 400 Horse Power.

Boilers of Steel and Iron supplied to the trade or the user. Send for Catalogues.

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List of Second-Hand Machines, taken in Exchange for New Tools.

24 in. Swing	22 ft.	Bed	Shafting Lathe,	Providence.
36 " "	12 "	"	Engine "	Putnam.
33 " "	12 "	"	" "	Portland Co.
18 " "	8 "	"	" "	Flather.
18 " "	7 "	"	" "	D. W. Pond.
18 " "	9 "	"	" "	Star.
17 " "	5½ "	"	" "	Shepard.
15 " "	6 "	"	" "	Fitchburg.
12 " "	5 "	"	" "	Prentice.

Putnam Gap Chucking Lathe, 60 in. swing, 9 ft. bed.
Monitor Brass Lathe, 18 in. swing, 5 ft. bed.
Providence Planer, planes 24 in. wide, 5 ft. long.
Hendey " " 24 " " 6 " "
Bement " " 30 " " 8 " "
Hendey Shaper. 24 in. stroke. Fine condition.
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" " " 18 " " "
Garvin No. 2 Gang Drill, 2 spindles.
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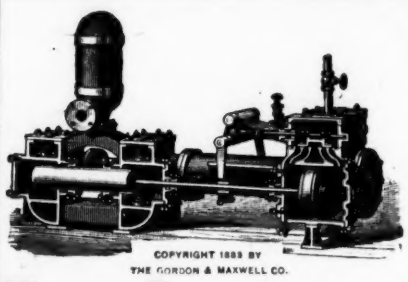

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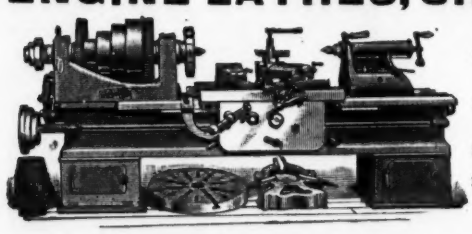
ENGINE LATHES, SHAPERS & DRILLS



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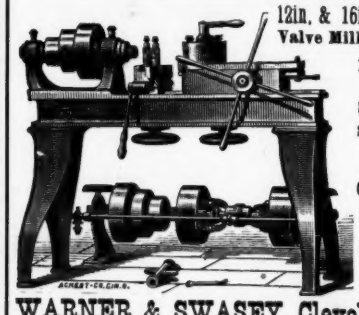

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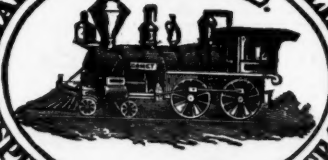

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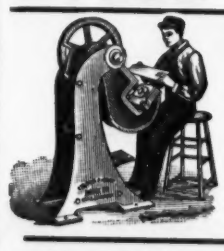

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